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# Editorial

The Editorial Board of the Nepal Geological Society is very happy to bring out the Volume 14 of the NGS News Bulletin.

One of the main activities of the Nepal Geological Society (NGS) is the regular publication of the scientific journal and the News Bulletin. The **Journal of Nepal Geological Society** is the scientific publication and is published every year in the month of June. It includes scientific research papers with emphasis on the Himalaya Region. This journal is one of the important regular scientific publications from Nepal and has a fairly large circulation both in Nepal and abroad. The **News Bulletin** is another important publication of the Nepal Geological Society. The main objective of this publication is to reach to a wider section of the people with message on the role of geoscience for the overall development of the country. It includes, for example, the relationship between geoscientific researches and economic development, environmental protection, natural hazard mitigation and management, practical use of geology in infrastructure development etc. It includes popular scientific articles, and also information on the important activities of the Society, announcements, advertisements etc. The Bulletin is distributed free of cost.

The present volume of the Bulletin contains information regarding various events organized by the Society in the last one year period as well as short popular articles primarily written for the non-professionals on various aspects of geoscience. All the abstracts of the papers presented in the National Meeting cum Seminar organized to observe the IDNDR-Day (1996), Biennial report of the NGS, Auditors report and speeches of various distinguished guests delivered in various functions of the Society are also included. Besides this, a list of publications of NGS, name and address of new NGS Members and information about Second Nepal Geological Congress are included in the Bulletin.

The number of NGS members are gradually increasing and correspondingly, the professional activities of the society are also increasing day by day. As a result, there are more materials to be included in the Bulletin. Therefore, the size of the Bulletin is also gradually increasing. We have tried our best to include all related and important information in the Bulletin and, we hope that this volume will be useful and interesting to our readers.

The Society would like to express hearty welcome to its new members. On the auspicious occasion of the 47<sup>th</sup> National Democracy Day, the Society also extends its best wishes to all its members and our readers as well as well wishers.

The Editorial Board is highly thankful to those who have helped in various ways to bring out this volume. We are equally thankful to all the industries and consulting companies who have helped us by providing advertisement, without whose support it would have been difficult to bring out this publication in this form.

**DO YOU KNOW ?**

- Earthquake is one of the major destroyers of lives and properties.
- More than 15,25,000 people have died in this century due to fatal earthquakes.
- With more than 11,570 deaths, Nepal ranks 15th in earthquake related casualties.
- More than 75% casualties throughout the world are attributed to building failure.
- In Nepal, more than 95% earthquake related deaths are due to collapse/damage of buildings that have been designed and constructed without seismic safety

**DO YOU ALSO KNOW ?**

- In Nepal, in an average, major earthquakes have been occurring every 100 years and medium earthquakes every 50 years.
- The great earthquake of 1934 (1990 B.S.) destroyed/damaged more than 207,200 buildings in Nepal and killed 8,519 persons.
- A building designed and constructed incorporating seismic safety measures saves lives and properties during an earthquake.
- We tend to spend lavishly on the finishing (marble, tiles, granite, plaster of paris etc.) but compromise on professional design, supervision, and safety requirements.
- Incorporating earthquake safety measures in buildings would require only additional 2 to 6 percent cost.
- We can also strengthen existing buildings against seismic risks by retro-fitting.

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## NGS NEWS

The 17th Annual General Body Meeting of the Nepal Geological Society was held on 30 August 1996 (14 Bhadra 2053) at the Conference Hall of Hotel Himalaya, Lalitpur. At the beginning Mr. K.P. Kaphle, the President delivered a welcome speech and Dr. R.B. Shrestha, Secretary and Mr. B.R. Aryal, Treasurer, presented the biennial report and financial report, respectively. Mr. D.N. Subedi, Secretary Elect (9th Executive Committee), presented the future working plan and activities of the Society. It was followed by the active discussion on various points on the proposal on amendment of Bylaws and further broad range of discussion on various topics and issues related to the activities of the Society.

8th Biennial Function of the Society was organized in Hotel Himalaya, Lalitpur in the evening of 30 August 1996. The function was chaired by Dr. B.N. Chalise, Secretary, Ministry of Industry and it was graced by the chief guest Hon. Minister for Industry Mr. D.R. Shastri. The function was also attended by Hon. Asst. Minister Mr. G.J. Shah, high ranking officers of HMG Nepal, distinguished foreign and national guests, journalists and members of the Society as well as their spouses. The function began with the welcome speech by the outgoing President of NGS Mr. K.P. Kaphle and followed by the speech by Dr. B.N. Upreti, President Elect. Dr. Upreti highlighted on the future programme and objectives of the Society on behalf of newly elected office bearers of the 9th Executive Committee of NGS. Hon. chief guest, Minister of Industry Mr. D.R. Shastri addressed to the gathering and also released an earthquake awareness booklet entitled "*Bhookampa Ko Vinas Bata Kasari Jogine*" published by NGS in cooperation with the National Society of Earthquake Technology Nepal and Lutheran World Service/Nepal. The Chairman of the function Dr. B.N. Chalise expressed the happiness on the activities of

the Society. At the end Mr. D.N. Subedi, Secretary Elect delivered the vote of thanks.

The Nepal Geological Society in cooperation with HMG, Ministry of Home, Disaster Prevention Technical Centre (DPTC), and UNDP/Nepal successfully organized a one day National Meeting cum Seminar on "Understanding Our Physical Environment: Key to Natural Disaster Reduction" in Kathmandu on October 9, 1996 to commemorate the UN declared International Decade for Natural Disaster Reduction (IDNDR) Day 1996. Inaugural session was followed by two Technical Sessions. A resolution was adopted by the participants in the concluding session.

On the occasion of the IDNDR-Day, Nepal Geological Society in collaboration with Lutheran World Service, Nepal Disaster Preparedness Project organized one day workshop cum training on "Natural Disaster Preparedness" to high school teachers in Kathmandu on 27 November 1996. It was participated by 30 teachers from various high schools based on Kathmandu. In the inaugural speech the Chief Guest Hon. Minister of Education Mr. G.R. Joshi and Mr. P.L. Singh, Chairman of the inaugural function and Mayor of Kathmandu Municipality expressed their feelings and appreciated such activities of Nepal Geological Society.

NGS also organized a talk programme at the auditorium of the Department of Mines and Geology on September 17, 1996. The scientific talk was delivered by Dr. G. Fuchs of Austria on "Multiphase Tectonics in the Indus Suture Zone in Ladakh".

NGS in cooperation with National Society of Earthquake Technology Nepal and with the financial support of the Lutheran World Service/Nepal, Disaster Preparedness Project published and distributed the

Earthquake Awareness Booklets entitled "Bhookampa Ko Binas Bata Kasari Jogine" in August 1996. This booklet was released by Hon. Minister for Industry Mr. D.R. Shastri on the occasion of 9th Biennial Function of the Society on 30 August 1996 in Kathmandu.

**P**resident and other members of the Society met Mr. P. R. Ligal, Vice Chairman, National Planning Commission, Hon. Minister Mr. P.M. Singh, Minister of Population & Environment, and Mr S.N. Sharma, Secretary Ministry of Population and Environment, Hon. Minister Mr. D.R. Shastri, Ministry of Industry, Mr. P.P. Dahal, Secretary, Prime Minister's Office in their respective Ministry and handed over a request letters to include geoscientists in the Ministry of Population and Environment and provide

opportunities to work as an executive in the mineral based industries in Nepal.

**N**GS was also involved in the preparation of the National Action Plan on Natural Disaster Management in Nepal and worked in cooperation with the HMG Ministry of Home.

**E**lection of the office bearers of 9th Executive Committee of Nepal Geological Society was held on August 1996. Hand over ceremony to the newly elected members of the Society was held on 8th Biennial Function in presence of Chief Guests Hon. Minister D.R. Shastri, distinguished guests and members of NGS on 30 August 1996 at Hotel Himalaya, Lalitpur. The 9th Executive Committee took their office from 1 September 1996.

## **Congratulations**

**The Nepal Geological Society**  
*extends its hearty congratulations*  
*to its Life Members,*

**MR. GOPAL SINGH THAPA**

**Department of Mines and Geology,**  
*and*

**DR. BISHAL NATH UPRETI**

**Department of Geology, Tribhuvan University,**  
**Trichandra Campus**

*on being decorated by His Majesty the King*  
*with the medal of*

**Gorkha Dakshin Bahu**

*in 2053*



# नेपाल भौगर्भिक समाजको सत्रौं वार्षिक साधारण सभा

अगस्त ३०, १९९६, काठमाडौं, नेपाल

नेपाल भौगर्भिक समाजको सत्रौं वार्षिक साधारण सभा भाद्र १४, २०५३ (३० अगस्त १९९६) का दिन समाजका अध्यक्ष श्री कृष्णप्रसाद काफ्लेको अध्यक्षतामा होटल हिमालयको सभाकक्षमा सुसम्पन्न भयो । उक्त सभामा समाजका अध्यक्षले प्रस्तुत गर्नुभएको स्वागत भाषण तथा सचिव डा. श्री राजेन्द्रबहादुर श्रेष्ठले प्रस्तुत गर्नुभएको द्वयवार्षिकी प्रतिवेदन; कोषाध्यक्ष श्री

बाबुराजा अर्यालले प्रस्तुत गर्नुभएको समाजको आय-व्ययको विवरणका साथै नव निर्वाचित नवौं कार्यकारिणी समितिको तर्फबाट सचिव श्री देवीनाथ सुवेदीले प्रस्तुत गर्नुभएको आगामी कार्यक्रमहरू सहितको मन्तव्य र तत्पश्चात् विधान संशोधन एवं अन्य विभिन्न विषयमा भएको छलफल तल प्रस्तुत गरिएका छन् ।

## नेपाल भौगर्भिक समाजका अध्यक्ष श्रीकृष्ण प्रसाद काफ्लेबाट सत्रौं साधारण सभामा प्रस्तुत स्वागत भाषण

सर्वप्रथम म यस सत्रौं वार्षिक साधारण सभामा उपस्थित सम्पूर्ण सदस्य साथीहरूलाई आठौं कार्यकारिणी समितिको तर्फबाट हार्दिक अभिवादनका साथै यस सभामा स्वागत गर्दछु । यो सभा हाम्रो आठौं का.का.स. को कार्यकालको अन्तिम सभा भएकोले अत्यन्त महत्त्वपूर्ण छ । यस सभामा छलफलका लागि राखिएका विभिन्न विषयहरू र अन्य समसामयिक विषयहरूमा साथीहरूबाट सक्रिय भाग लिन र आफ्नो राय व्यक्त गर्न आग्रह गर्दछु ।

दुई वर्षअघि कार्यभार सम्हाल्दा हामीले अठोट गरेका समाजका विभिन्न कार्यक्रमहरू तथा तिनको सफल कार्यन्वयनबारे आठौं का.का.स.का. तर्फबाट यस सभाका सचिव डा. राजेन्द्र बहादुर श्रेष्ठले द्वयवार्षिक प्रतिवेदनमा प्रस्तुत गर्नुहुनेछ । तत्पश्चात् समाजका कोषाध्यक्ष बाबुराजा अर्यालले समाजको वार्षिक आय-व्यय विवरण पेश गर्नुहुनेछ र यस समाजको Rules and Regulations Subcommittee का संयोजक श्री अच्युतानन्द भण्डारीले विधान संशोधनको लागि समाजका सदस्यहरूबाट प्राप्त मन्तव्यको आधारमा तयार गरेको प्रतिवेदन प्रस्तुत गर्नु हुनेछ र यसमा आवश्यक परेका दफाहरूमा छलफल गरी विधान संशोधनको प्रकृया पूरा गरिने छ । यो प्रक्रिया अत्यन्तै लामो भएको हुँदा समस्त सदस्यहरूले विचार पुर्‍याई पारित गर्नु होला भन्ने मैले आशा राखेको छु ।

गत २ वर्षको हाम्रो कार्यकालमा हामीले जे-जति कामहरू सम्पन्न गरेर समाजलाई केही अगाडि बढाउन र अन्तर्राष्ट्रिय क्षेत्रमा यसको छवि पुर्‍याउन सक्यौं ती सबै हाम्रा सदस्य साथीहरूबाट प्राप्त सहयोग, सल्लाह, आलोचना र सुझावबाट नै सम्भव हुनसकेका हुन् । यहाँहरूको सहयोग बिना अन्तर्राष्ट्रिय सेमिनार तथा वर्कशपहरूको सफल

आयोजना गर्न, समयमा जर्नलहरूको प्रकाशन गर्न र आवश्यक आर्थिक सहयोग जुटाउन असम्भव नै थियो । यस अवसरमा यस समाजले संचालन गरेका विभिन्न कार्यक्रमहरूमा विभिन्न किसिमबाट सहयोग पुर्‍याउने, र राष्ट्रिय योजना आयोग सचिवालय, गृहमन्त्रालय, खानी तथा भूगर्भ विभाग, पेट्रोलियम अन्वेषण परियोजना, सिंचाई विभाग, भूमिगत जलश्रोत विकास परियोजना, नेपाल विद्युत प्राधिकरण, विद्युत विकास केन्द्र, रोनाष्ट, त्रिभुवन विश्व विद्यालय तथा विदेशी संस्थाहरूमा ICIMOD, UNDP, Lutheran World Service/Nepal, GTZ/BGR एवं यस समाजका शुभचिन्तक Consultancy Firms हरू र खनिजमा आधारित उद्योगहरूलाई म धन्यवाद ज्ञापन गर्दछु । आशा छ आउँदा दिनहरूमा पनि यी सबै संस्थाहरूबाट अझ बढी सहयोग प्राप्त हुने नै छ ।

यसै अवसरमा यस समाजको लागि केही आर्थिक श्रोत जुटाउन यस समाजलाई एक हजार थान नेपालको भौगर्भिक नक्सा उपलब्ध गराई बिक्री वितरण गर्ने व्यवस्था गरिदिनु भएकोमा ICIMOD तथा यस समाजका सदस्य श्री कृष्ण मुरारी अमात्यलाई, त्यसैगरी "भूकम्पको विनाशबाट कसरी जोगिने ?" नामक निर्देशन पुस्तिका तयार गर्न सदा सहयोग गर्नु भएकोमा यस समाजका पूर्व अध्यक्ष श्री आमोदमणि दीक्षित र सदस्य श्री महेश नकमी तथा यस समाजको जर्नल एवं सेमिनार प्रोसिडिङहरू प्रकाशनमा ल्याउन प्रशस्त समय दिई सहयोग गर्ने डा. विशाल नाथ उप्रेती तथा डा. मेघराज धिताल र यस समाजको हरेक कार्यमा अग्रसर भई अत्यन्त क्रियाशील रही सहयोग पुर्‍याउनु हुने हाम्रा का.का.स.का सह-सचिव श्री श्याम के.सी.लाई म विशेष धन्यवाद दिन चाहन्छु ।

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हाम्रो यत दुई वर्षको कार्यकालमा हामीले यस समाजलाई अघि बढाउन जे-जति गर्न सक्यौं सम्पूर्ण साथीहरूको माझमा छैछौं । तर दुःखको कुरा हाम्रो प्रयास हुँदा हुँदै पनि समाजको आफ्नो कार्यालय भवन निर्माण एवं Geoscience Library को स्थापनाको लागि जग्गा उपलब्ध गराउन अझै सकिएको छैन । त्यसैगरी समयाभाव र आर्थिक अभावको कारण First Nepal Geological Congress को Proceedings प्रकाशन गर्न केही ढिलाई हुने भएको छ । आशा छ आउँदा दिनहरूमा नवौं का.का.स. ले यस कार्यमा विशेष ध्यान दिई जग्गा उपलब्ध गराउन र प्रोसिडिङ्ग प्रकाशन गर्न सक्षम हुनेछ ।

यसरी आफ्नो २ वर्षको छोटो कार्यकालमा सदस्य साथीहरूको सहयोगले समाजको उद्देश्य अनुरूप कार्यक्रमहरू स्वच्छ बातावरणमा सफल संचालन गर्न र समाजको अध्यक्ष

जस्तो महत्त्वपूर्ण पदमा रही आफ्नो बुद्धि विवेकले भ्याएसम्म समाजलाई अगाडि बढाउने कार्यमा संलग्न भई थप धेरै अनुभव संकलन गर्ने मौका प्रदान गर्नुभएकोमा म यस समाजका सम्पूर्ण सदस्य साथीहरूलाई पुनः एक पटक धन्यवाद दिन चाहन्छु ।

अन्त्यमा समाजको कार्यकारिणी समितिको पदावधि हालसम्म २ वर्षको हुने गरेकोमा समाजको क्रियाकलापको स्तर बढेको र यसको अन्तर्राष्ट्रियस्तरमा पनि सम्पर्क बढ्दै गएको तथा यसले गर्नुपर्ने वैज्ञानिक भेलाहरूको आयोजनाका लागि पनि अबदेखि २ वर्षको कार्यकाल पर्याप्त नहुने देखिएकोले व्यक्तिगत रूपमा का.का.स. को पदावधि ३ वर्षको हुनुपर्ने आवश्यकता भैले महसूस गरेको कुरा यस सभा समक्ष निवेदन गर्दछु ।

धन्यवाद ।

## Annual Report by Dr. Rajendra B. Shrestha, Secretary, NGS

Mr. Chairman,  
Respected Members of the Society,

It gives me a great pleasure to welcome you all to the 17th Annual General Body Meeting of the Nepal Geological Society on behalf of the Executive Committee and myself in person. It has already been two years since we took the office of the Executive Committee of the Nepal Geological Society. The Nepal Geological Society has made significant achievements in the past years in fulfilling the objectives of the Society. It has received appreciation both from international community of geoscientists and policy makers of the country. During the last two years during our stay in this prestigious office of the Executive Committee of the Society, we tried our best to enhance the image of the Society and reaching towards fulfillment of its objectives.

We have worked to the extent possible in running daily activities of the Society as smoothly as possible. In this connection, I would like to inform you that in total the Executive Committee met for 20 times and made various decisions.

As you are aware of, the tradition of organizing biennial function of the Society

is being continued in cooperation with the newly formed 9th Executive Committee this evening at 7 o' clock.

Continuing the observance of the 1990's decade as the International Decade for Natural Disaster Reduction (IDNDR), day-long National Meeting cum Seminar was organized on October 5, 1994 and October 9, 1995. At the end of the meeting cum seminars, Resolutions were also adopted by participants and the adopted Resolutions have already been forwarded to the concerned national and international organizations including the office of the Prime Minister at Singhdurbar.

Journal and News Bulletin publication of the Society is being continued. In this connection, proceeding of the 9th Himalaya-Karakorum-Tibet Workshop has been published as volume 11 (Special Issue). The publication of regular issue i.e. volume 10 of Journal of Nepal Geological Society has also been published. The reprints of articles from the proceeding volumes and volume 10 has already been sent to the respective authors. Volume 13 is already in the press and will be coming out within a next few days. The abstract volume of the First Nepal Geological Congress (Volume 12, Special Issue) and the

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5. **Testing and Monitoring Quality Standards.**
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7. **Environmental Impact Studies.**



regular issues of the News Bulletin of the Society (volume 12 and 13) has also been published.

As promised to the esteemed General Body about a year ago, we have published the Nepal Geological Society Members Directory. I believe it will be handy and useful for the members of our Society. Of course it needs regular updating, and hope it will be done in future. Similarly, a booklet on raising awareness on earthquake disaster to the Nepalese people living both in rural and urban areas titled "Bhukumpa ko binash bata kasari jogine?" is going to be released this evening which is prepared in cooperation with the National Society for Earthquake Technology, Nepal and Lutheran World Service, Nepal.

As per the decision made by the General Body during the 15th Annual General Body Meeting, questionnaires regarding amendment of By-Laws of the Society as proposed by the Rules and Regulation Sub-Committee, was circulated to all the members of the Society. The returned questionnaires with the opinion by the individual members of the Society were submitted to Mr. Achyutananda Bhandary, coordinator, Rules and Regulation Sub-Committee for further work. The draft proposal on amendment shall be presented by Mr. Bhandary in today's General Body Meeting for discussion and necessary action.

With regret, I have to report to the respected Members of the Society that we have not been able to acquire the land in the premise of the Department of Mines and Geology (DMG) for construction of the Society's building. We wrote to the Director General of the DMG after receiving favourable assurances from the Ministry of Industry and the DMG. Both the department and the ministry forwarded our request to the Ministry of Finance with favourable notes. However, at the final stage, the Ministry of Finance decided against our favour. Let us hope that the newly elected 9th Executive Committee will be successful in pursuing this matter further in favour of the Society.

Two scientific talk programs were organized with the cooperation of Scientific Sub-Committee. The first lecture was delivered by Mr. Raja Bhai Bajracharya on Seismic Macrozonning of Nepal in October 28, 1994. Prof. Muhammad Qasim Jan, Director, National Center of Excellence in Geology, University of Peshawar, Pakistan gave a talk on Petrological Evolution of Kohistan Magmatic Arc in the Himalaya of Pakistan on July 13, 1995.

To commemorate the 15th anniversary of the Society, *First Nepal Geological Congress (NGC-I)* was organized in which many geoscientists from Nepal and abroad participated. This was an opportunity to our Nepalese members for sharing of knowledge and experiences as well as dissemination of findings of geological researches among the foreign participants. We are of firm opinion that it has contributed to a certain degree in the fulfillment of the objectives of our Society.

Similarly, we also organized a "*Scientific Writing Workshop*" from September 17 to 19, 1995 with a view that it will be beneficial to the members of the Society and other participants in further strengthening the technical writing skills. The Scientific Writing Workshop was conducted by Prof. P. G. Cooray from Sri Lanka who had conducted such workshops for geoscientists, engineers, managers and others in different countries of Asia, and it was the 48th workshop in series. It is worthy to note that such a kind of workshop was organized for the first time in Nepal and it was participated by 45 professionals from various disciplines such as geologists, engineers, researches representing various government organizations, university, international organizations and different consulting agencies.

I would like to inform you that the American Geological Institute has published the name and address of the Nepal Geological Society in the International Directory of Geosciences Organizations in 1994. Recently, the Nepal Geological Society has established a bilateral relation with the Association of

Geoscientists for International Development (AGID) and International Association of Engineering Geologists (IAEG). The Nepal Geological Society is the focal point in Nepal regarding the activities of AGID and IAEG. Members of the Nepal Geological Society who would like to become members of the AGID or IAEG could apply for membership through the Society and arrangement has been made for the convenience of the members of the Society to pay their necessary fees in Nepalese rupees. Also, we had a meeting with the Executive Committee of the Association of Exploration Geophysicists, Hyderabad, India and as per their invitation, two members of the Executive Committee shall be participating during the seminar on "Geophysics Beyond 2000" to be held on 15th to 20th November, 1996. An understanding was made that discussion on creation of some form of "Forum of South Asia on Geoscience" shall be taken at that time and the NGS should also make its contribution towards it.

The strengthening of NGS library is a matter of great importance to us, and in this respect, we have made some progress. To add to the Society's Library collection, we are receiving *Himalayan Notes* (an international newsletter on the Natural History, Earth Sciences and the Environment of the Himalaya, Karakorum and Tibet) regularly from Department of Geology, Arizona State University via Institute of Geology, Department of Geosciences, Zurich, Switzerland. The exchange program of publication has also been started with the Wadia Institute of Himalayan Geology, India.

The representation of the Society in various institutions or national committees such as IGCP, RONAST, Environmental Protection Council, etc. has always been a matter of concern. Please be informed that our society now has become the member of the IDNDR National Committee. Similarly, the Society approached to the Prime Minister, Vice-Chairman of the National Planning Commission, and Minister of Population and Environment and briefed them regarding contributions that geoscientists can make in the infrastructure development of the

country and alleviating the environmental degradation, and also the importance of the role of geoscientists in the national development program.

Also, on behalf of the Society, we met Minister of Industry and appealed to make an arrangement to give room for geoscientists to the positions of managerial and decision making level in mineral based industries so that geoscientists receive their good share in return for hard work done in developing those mineral based industries.

I would also like to inform the General Body that the Society has a total of 405 members by now, out of which 375 are full members and 30 are associate members. Out of 375 full members, international members from various countries make up 35% of total (i.e. 132 are international members) and Nepalese members make up 65% (243 Nepalese members).

Dear Members, whatever have been achieved in meeting the objectives of the Society, it has always been with your help, support and advice. At this moment, on behalf of the Executive Committee and personally myself, I would like to offer our sincere thanks to all of you for your active cooperation and continued support in whatever way we needed at various times. Also, various governmental and non-governmental agencies, organizations, consulting and business groups as well as international agencies had provided technical, logistic and financial support to the Society and the 8th Executive Committee would like to extend heartfelt thanks to those organizations and agencies and hope that such cooperation will be continued in future also. Particularly, I would like to mention here the names of following organizations:

- Department of Mines and Geology,
- Petroleum Exploration Promotion Project,
- Ground Water Resources Development Project, Department of Irrigation,
- Central Department of Geology, Tribhuvan University,
- Department of Geology, Tri-Chandra Campus,
- Nepal Electricity Authority,
- Electricity Development Center,
- Ministry of Home,

- Secretariat of National Planning Commission,
- Royal Nepal Academy of Science & Technology (RONAST),
- Water Induced Disaster Prevention Technical Centre (DPTC),
- International Centre for Integrated Mountain Development (ICIMOD),
- United Nations Development Program (UNDP),
- GTZ/BGR,
- Lutheran World Service, Nepal.

On behalf of the 8th Executive Committee, I would also like to thank Mr. Krishna Murari Amatya and Mr. Bharat Mani Jnawali who have made material contribution to the Society by providing 1000 copies of Geological Map of Nepal through ICIMOD by which the Society has been able to raise some fund (approximately Rs. 15,000) so far. Similarly, the 8th Executive Committee would like to extend its sincere thanks to various sub-committees for carrying out various activities of the Society smoothly and helping the Executive Committee in all

possible ways. Sincere thanks are also due to all the donors, advertisers and sponsors for the support in various activities of the Society. Last but not least, the 8th Executive Committee wishes to extend its heartfelt thanks to the esteemed General Body for its constant support, suggestions and criticism during the last two years.

If there has been any shortcomings or weakness on our part, I would like to take this opportunity to express sincere apology on behalf of the Executive Committee just before we leave the office of the Executive Committee. Also at this moment, we would like to assure to the newly elected ninth executive committee that we will be available for any kind of help for a smooth transition of the office.

Finally, allow me to congratulate the newly elected members of the 9th Executive Committee and I wish them a great success in their endeavor for further development of the Society and Geoscience.

Thank you, thank you very much for your time. □

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# Auditor's Report 1995-96 (2052-053 BS)

The Members  
Nepal Geological Society  
Kathmandu.

Gentlemen,

I have audited the attached Receipt & Payment Account for the year ended 32nd Shrawan 2053 and reports as follows:

1. I have got all the information and explanations which are required for the purpose of audit.
2. Proper books as required are maintained according to Company's Law
3. The attached Receipt & Payment Account and Income & Expenditure Account are drawn properly up in accordance with records which are made available to me.
4. According to the information given to me the attached Income & Expenditure Accounts prepared for the year ended 32nd Shrawan 2053 exhibit true and fair view

Sd.

(Babu Raja Bajracharya)

Registered Auditor

Date: 17th Chaitra 2053

## NEPAL GEOLOGICAL SOCIETY

### RECEIPT & PAYMENT ACCOUNT

For the year ended 32nd Shrawan 2053

<b>Receipt</b>	<b>Amount</b>	<b>Payment</b>	<b>Amount</b>
To Cash	6,608.43	By Advertisement	4,230.50
To Bank	461,894.15	By Auditor's Fee	4,000.00
To Contribution from Others	34,260.00	By Advance (P. Man)	10,000.00
To Miscellaneous Income	9,958.60	By Computer Service	4,650.00
To Interest Received	16,439.24	By Fuel	505.00
To Life Member Fee	13,000.00	By Hotel Bill	82,304.74
To Associate Member Fee	400.00	By Miscellaneous	705.00
To Ordinary Member Fee	3,820.00	By Photocopy	11,931.00
To Registration Fee	12,000.00	By Postage & Telex	5,279.00
To Journal Sales	49,254.80	By Printing & Press	90,505.00
To Map Sales	16,534.00	By Refreshment	1,013.00
To Seminar/Workshop	46,550.00	By Remuneration and Salary	7,556.00
		By Rent	3,000.00
		By Repair & Maintenance	150.00
		By Tax on Interest	136.34
		By Taxi Fare	350.00
		By Souvenir Bag	30,520.00
		By Stationery	4,697.00
		By Seminar/Workshop	24,861.19
		By Balance:	
		• Nepal Bank, Lazimpat	8,215.25
		• Nepal Bank, Bhotahiti	9,949.60
		• Nepal Bank, Fixed	37,000.00
		• Nepal Bank, Saving	2,822.78
		• Nabil Bank, Saving	5,165.24
		• Nabil Bank, Fixed	29,000.00
		• Nabil Bank Dollar (4249.90)	242,244.30
		• Agri. Dev. Bank, Saving	11,211.08
		• Agri. Dev. Bank, Fixed	37,000.00
		• Cash in Hand	
		• Cash	1,717.19
	<b>670,719.22</b>		<b>670,719.22</b>
Sd. Treasurer	Sd. Secretary	Sd. President	Sd. Auditor

**Best Wishes and Hearty Felicitations  
on the Auspicious Occasion of  
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- **Construction management and supervision of construction works etc.**

## NEPAL GEOLOGICAL SOCIETY

## INCOME &amp; EXPENDITURE ACCOUNT

For the year ended 32nd Shrawan 2053

<i><b>Expenditure</b></i>	<i><b>Amount</b></i>	<i><b>Income</b></i>	<i><b>Amount</b></i>
To Advertisement	4,230.50	By Contribution (Other)	34,260.00
To Auditor Fee	4,000.00	By Misc. Income	
To Computer Service	4,650.00	(Exchange of Dollar)	9,958.60
To Fuel	505.00	By Interest Received	16,439.24
To Hotel Bill	82,304.74	By Life Member Fee	13,000.00
To Miscellaneous	705.00	By Associate Member Fee	400.00
To Photocopy	11,931.00	By Ordinary Member Fee	3,820.00
To Postage and Telex	5,279.00	By Registration Fee	12,000.00
To Printing & Press	90,505.00	By By Journal Sales	49,254.80
To Refreshment	1,013.00	By Map Sales	16,534.00
To Remuneration and Salary	7,556.00	By Seminar/Workshop	46,550.00
To Rent	3,000.00	By Hotel (G.M.M.)	80,795.00
To Repair & Maintenance	150.00	By Dollar (224x55)	12,320.00
To Tax on Interest	136.34		
To Taxi Fare	350.00		
To Souvenir Bag	30,520.00		
To Stationery	4,697.00		
To Seminar/Workshop	24,861.19		
To Advance (P. Man)	10,000.00		
To Surplus (excess of income over expenditure)	8,937.87		
	<u>295,331.64</u>		<u>295,331.64</u>
<i>Sd.</i> Treasurer	<i>Sd.</i> Secretary	<i>Sd.</i> President	<i>Sd.</i> Auditor

*Felicitations & Best Wishes*  
*on*  
*The Auspicious Occasion*  
*of*  
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## नेपाल भौगर्भिक समाजका नवनिर्वाचित सचिव श्री देवीनाथ सुवेदीबाट सत्रौं वार्षिक साधारण सभामा प्रस्तुत मन्तव्य

श्रीमान् सभापति महोदय, यस समाजका सम्मानित सदस्यज्यू आदरणीय पूर्व अध्यक्षज्यूहरू एवं सम्पूर्ण सदस्य साथीहरू,

सर्वप्रथम यस नेपाल भौगर्भिक समाजको नवौं कार्यकारिणी समितिमा हामीलाई सर्वसम्मतिबाट निर्वाचन गरी समाजलाई अगाडि बढाउने अभिभारा दिनुभएकोमा यस समाजका सम्पूर्ण सदस्य साथीहरूलाई नव निर्वाचित कार्यकारिणी समितिको तर्फबाट म हार्दिक धन्यवाद ज्ञापन गर्दछु।

हाल यस समाजले १६ वर्ष पूरा गरी १७ वर्षमा प्रवेश गरिरहेको छ र यस समाजको स्थापना कालदेखि नै आफ्नो मूलभूत उद्देश्य अनुरूप भूगर्भ विज्ञानको विकास एवं सम्बर्धन गरी राष्ट्रिय विकासको लागि विभिन्न क्षेत्रहरूमा यस समाजद्वारा संचालित विभिन्न वैज्ञानिक कार्यक्रमहरूको माध्यमबाट आवश्यक योगदान पुऱ्याउँदै आइरहेको सबीबिदै छ।

विगतका दिनहरूमा यस समाजद्वारा संचालन गरेका कार्यक्रम र तिनको उपलब्धीका बारेमा सचिव डा. श्री राजेन्द्र बहादुर श्रेष्ठबाट प्रस्तुत द्व्यवार्षिक प्रतिवेदनमा उल्लेख भइसकेको छ। यस समाजले विगतमा गरेका उपलब्धीहरूलाई केलाएर हेर्दा राष्ट्रिय तथा अन्तर्राष्ट्रिय वैज्ञानिक संस्थाहरूबाट यस समाजलाई प्रशंसा गर्नुका साथै सक्दो सहयोग प्रदान गर्दै आइरहेको पाइन्छ। आगामी दिनहरूमा पनि यस समाजले थप नयाँ कार्यक्रमहरू सम्पन्न गर्न अझ बढी अग्रसर हुने र समाजको गरिमा उच्चस्तरमा पुऱ्याउन यस नवनिर्वाचित कार्यकारिणी समिति दृढ संकल्पित छ। यसको लागि हाम्रा सम्पूर्ण सदस्य साथीहरूबाट हर क्षेत्रमा सक्रिय सहयोग प्राप्त हुने नै छ भन्ने हाम्रो पूर्ण विश्वास छ।

विगत केही वर्षयता यस समाजले सम्पन्न गरेका महत्त्वपूर्ण उपलब्धीहरूले समाजको प्रतिष्ठा राष्ट्रिय तथा अन्तर्राष्ट्रिय क्षेत्रका वैज्ञानिक समुदायहरूमा बढ्दो पुगेको कुरा यस समाजले सफलताका साथ सन् १९९३ मा काठमाडौंमा आयोजना गरेको "Seminar on Hydrology with a special colloquium on Environmental Problems and Water Resources of Himalayan Region" विषयमा अन्तर्राष्ट्रिय सेमिनार, सन् १९९४ मा आयोजना गरेको International "9th Himalaya-Karakorum-Tibet Workshop", र सन् १९९५ मा सम्पन्न गरेको First Nepal Geological Congress बाट स्पष्ट हुन आउँछ। यसका साथै संयुक्त राष्ट्रसंघको आह्वानमा हर वर्ष अक्टोबरको दोस्रो बुधवार IDNDR-Day मनाउने सिलसिलामा एक दिने Seminar cum Meeting को आयोजना गर्दै आएको र अन्य यस किसिमका अन्तर्राष्ट्रिय वैज्ञानिक संस्थाहरूसँग bilateral सम्बन्धको विस्तारबाट स्पष्ट हुन आउँछ।

समाजले सम्पन्न गरेका विभिन्न सकारात्मक क्रियाकलापका बावजूद बितेका वर्षहरूमा सदस्य महानुभावहरूबाट उठाइएका निम्न विषयहरूको परिपूर्ति र कार्यान्वयन गर्न यस कार्यकारिणी समिति कटिबद्ध रहनेछ।

- समाजको कार्यालय भवन तथा National Geoscience Library स्थापनाको लागि जग्गा उपलब्ध गराउने सम्बन्धमा पूर्व कार्यकारिणी समितिबाट भए गरेको प्रयास अत्यन्त सन्तुष्टीपूर्ण छ, तापनि यसको समाधान अझ भइसकेको छैन।
- भूगर्भविदहरूको प्रतिनिधित्व हुनुपर्ने कतिपय महत्त्वपूर्ण स्थानहरूमा औपचारिकरूपमा कुराकानी भएतापनि त्यसको कार्यान्वयन अझसम्म हुनसकेको छैन। बातावरण मन्त्रालय, सडक विभाग, भू-संरक्षण विभाग, जल उत्पन्न प्रक्षेप नियन्त्रण केन्द्र (DPTC) र अन्य कतिपय खनिजमा आधारित उद्योगहरूमा समेत भू-वैज्ञानिकहरूलाई पदस्थापना गर्ने तर्फ प्रभावकारी कदम चाल्नु पर्ने आवश्यकता देखिन्छ।
- जर्नल तथा न्यूज बुलेटिनहरूको प्रकाशन वार्षिकरूपमा भइरहेको भएतापनि अझ स्तरीय बनाउँदै लैजान र विक्री वितरण प्रणाली र आदान-प्रदानको लागि स्वदेश तथा विदेशमा औपचारिक पत्राचार प्रभावकारीरूपमा गर्दै लैजान पर्ने आवश्यकता देखिन्छ।
- सन् १९९७ मा Second Nepal Geological Congress को आयोजना गरी सम्पन्न गराउन आवश्यक तयारीको लागि कार्यक्रम शुरु गरिने छ।
- सन् २००१ मा नेपालमा सार्क स्तरीय भौगर्भिक सम्मेलन (चौथो GEOSAS) को सफल आयोजना गर्न नेपाल भौगर्भिक समाज श्री ५ को सरकारलाई आवश्यक सहयोग पुऱ्याउन तत्पर छ र प्राविधिक कार्यको लागि यो समाज सक्षम पनि छ तर यसको लागि आवश्यक पूर्वाधार तयार गर्न श्री ५ को सरकारले समयमै बजेट लगायत अन्य कतिपय अत्यावश्यक वस्तुहरूको तर्जमा गर्नु नितान्त आवश्यक छ। यसको सफलताको लागि सम्बन्धित ठाउँहरूमा पहुँच पुऱ्याउन यस क.क.स.ले आवश्यक कदम चाल्नेछ।
- नेपाल भौगर्भिक समाजले सन्चालन गर्दै आएका कार्यक्रमहरू जस्तै IDNDR-Day को सिलसिलामा गरिने कार्यक्रम वार्षिक, Regular रूपमा प्रकाश हुने Journal of Nepal Geological Society / News Bulletin समयमा प्रकाश गर्ने, Talk Programme, Seminar र गोष्ठी आदिको आयोजना अझ प्रभावकारीरूपमा सम्पन्न गर्नेतर्फ यो कार्यकारिणी समिति अग्रसर हुनेछ।

अन्तमा सदा झै समाजबाट थालनी भएका कतिपय कार्यहरूलाई पूरा गर्न तथा थप क्रियाकलापहरूलाई अगाडि बढाउनुकासाथै विभिन्न कार्यमा गति प्रदान गर्दै प्रभावकारि रूपमा सम्पन्न गर्नको लागि यस समाजका सम्पूर्ण साथीहरूको सहयोग, सल्लाह र आलोचना सदा सर्वदा पाउने अपेक्षा राख्दै समाजको क्रियाकलापहरूलाई अझ बढि प्रभावकारी बनाउन यो क.क.स. सदा सजग रहनेछ भन्दै आफ्नो छोटो मन्तव्य यहाँ टुङ्ग्याउन अनुमति चाहन्छु।

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## सत्रौं वार्षिक साधारण सभामा भएका छलफल तथा निर्णयहरू

भाद्र १४, २०५३ (३० अगस्त १९९६) का दिन अपरान्ह होटल हिमालयको सभाकक्षमा बसेको यस समाजको सत्रौं वार्षिक साधारण सभामा समाजका अध्यक्षले स्वागत भाषण दिनुभएको थियो भने सचिवले द्वय वार्षिकी प्रतिवेदन र कोषाध्यक्षले आर्थिक प्रतिवेदन प्रस्तुत गर्नुभएको थियो । उक्त बैठकमा यस समाजका Rules and Regulations Subcommittee का संयोजक श्री अच्युतानन्द भण्डारीले प्रस्तावित संशोधित विधान पेश गर्नुभएपछि संशोधन गर्नुपर्ने बुँदाहरूमा विस्तृत छलफल गरी संशोधन गर्ने प्रकृया पूरा गरियो । यसकासाथै केहि प्रस्तावित अन्य विषयमा पनि विस्तृत छलफल गरी प्रस्तावहरू पारित गरिएको थियो । उक्त अवसरमा नव निर्वाचित नवौं कार्यकारिणी समितिकतर्फबाट नव निर्वाचित सचिव श्री देवीनाथ सुवेदीले आफ्नो मन्तव्य व्यक्त गर्दै भावि कार्यक्रमहरूबारे प्रकाश पार्नुभएको थियो । विधान संशोधित बुँदाहरूमा छलफल गर्ने क्रममा डा. चन्द्रकान्त शर्मा, श्री गोपालसिंह थापा, डा. रमेशप्रसाद बस्याल, डा. विशालनाथ उप्रेती, श्री कृष्णप्रसाद काफ्ले, श्री आमोदमणि दीक्षित, डा. तोरण शर्मा, डा. दिव्यरत्न कंसाकार, श्री निरेन्द्रध्वज मास्के, श्री रमेश अर्याल, श्री कृष्णमुरारी अमात्य, श्री हेमनाथ घिमिरे, श्री प्रयागमान प्रधान, श्री राधाकृष्ण कार्की, श्री विनोदसिंह क्षेत्री आदि सदस्यहरूले आफ्ना मन्तव्य व्यक्त गर्दै केहि प्रस्तावहरू प्रस्तुत गर्नुभएको थियो ।

- NGS को सदस्यता दिने सम्बन्धमा डा. विशालनाथ उप्रेतीले इन्जिनियरिङ्ग विषयमा B.E. गरेर बातावरण विषयमा थप अध्ययन/तालीम गरेको व्यक्तिलाई पनि सदस्यता दिन राम्रो हुन्छ कि भन्ने राय व्यक्त गर्नुभयो भने डा. तोरण शर्माको दायरा कति फराकिलो पार्ने हो त्यसमा भरपर्ने कुरा हो भन्नुभयो । त्यसैगरी गोपालसिंह थापा, कृष्णप्रसाद काफ्ले, निरेन्द्रध्वज मास्के, कृष्णमुरारी अमात्य, डा. दिव्यरत्न कंसाकार र डा. उप्रेतीले आ-आफ्ना विचार प्रस्तुत गर्नुभएपछि "भू-बातावरणीय इन्जिनियरिङ्गमा डिग्री प्राप्त व्यक्ति हुनुपर्ने भन्ने प्रस्तावलाई सर्वसम्मतिबाट पास गरियो ।
- Associate Member लाई Full Member मा upgrade गर्ने सम्बन्धमा का.का.स.को सिफारिसमा साधारण सभामा दुई तिहाई मतले निर्णय गर्ने व्यवस्था भएकोमा अबदेखि बहुमतले निर्णय गर्ने कुरा पास भयो ।
- साथै साधारण सभाले अबदेखि सदस्यता शुल्क का.का.स. ले समय अनुसार निर्धारण गर्ने निर्णय गर्‍यो ।

- दुई वर्षभन्दा बढिसम्म आफ्नो सदस्यता शुल्क तिरी नविकरण नगरेका व्यक्तिकहरूलाई पनि सबै शुल्क तिरेमा पुनः सदस्यता प्रदान गर्ने निर्णय भयो ।
- विरोध बैठक बोलाउने सम्बन्धमा कम्तिमा १५% या २०% या २५% सदस्यले बैठक बोलाउनु का.का.स.लाई दरखास्त दिएमा सकिन्छ भन्ने सम्बन्धमा छलफल हुँदा धेरै सदस्यहरूले १५% राख्नु उचित हुन्छ भने डा. तोरण शर्माको संख्या तोम्न राम्रो हुने सुझाव दिनुभयो । पुनः छलफल हुँदा १५% सदस्यले बैठक बोलाउनु का.का.स. लाई दरखास्त दिनसक्ने कुरामा सर्वसम्मतिबाट पास भयो । तर उक्त विशेष बैठक बोलाउँदा समाजका २५% भन्दा बढि सदस्य उपस्थित नभै बैठक बस्न नसक्ने भन्ने निर्णय भयो ।
- साधारण सभा तथा विशेष बैठक बोलाउनु पर्नेभएमा पहिला एक महिना अगाडि सूचना गर्ने व्यवस्था रहिआएकोमा अब उपरान्त अवस्था हेरी कम्तिमा ७ दिनदेखि बढिमा ३० दिन अगावै सूचित गर्नेगरी सर्वसम्मतिबाट पास भयो ।
- महाअभियोगको प्रस्तावको विषयमा बैठक बोलाउँदा सूचनामा विषय उल्लेख गर्ने र महाअभियोग लगाएका व्यक्तिलाई बैठकमा सफाई दिने मौका प्रदान गर्ने कुरामा सबैको सहमति रह्यो ।
- का.का.स.को पदाधिकारीहरूमा सचिवको सट्टा महासचिव र उप-महासचिव गरी दुई पद राख्ने र का.का.स. सदस्य दुईजनाको सट्टा तीन र मनोनित सदस्यमा बढिमा ४ जनासम्म राख्ने र निवर्तमान अध्यक्ष पदेन सदस्य हुने व्यवस्था गर्ने कुरामा व्यापक छलफलपछि सर्वसम्मतिबाट पास भयो ।
- आमोदमणि दीक्षित र प्रयागमान सिंहले कोषाध्यक्षको पनि पद संख्या बढाउने हो कि भनेर ल्याउनु भएको प्रस्तावमा कृष्णप्रसाद काफ्लेले त्यस्तो आवश्यक परेमा का.का.स. सदस्यमध्येबाट कुनैलाई कार्यभार दिई गराउन सकिने हुँदा एकभन्दा बढि कोषाध्यक्ष आवश्यक नपर्ने भन्ने कुरामा सबैको सहमति रह्यो ।
- कृष्णप्रसाद काफ्लेले अबदेखि का.का.स.को कार्यकाल २ वर्षको बदला ३ वर्ष गराउने प्रस्ताव राख्नु भएकोमा विशालनाथ उप्रेतीले बढाउनु आवश्यक नभएको कुरा औल्याउनु भयो भने आमोदमणि दीक्षितले ३ वर्ष गर्नु उचित हुने कुरा पुष्ट्याउनु भयो र ३ वर्षको कार्यकाल गर्नेगरी सर्वसम्मतिबाट पास भयो ।

- श्री कृष्णमुरारी अमात्य र निरेन्द्रध्वज मास्केले का.का.स.को निर्वाचन सम्बन्धी नियम बनाउने सम्बन्धमा आजको बैठकमा छलफल गर्नुपर्ने प्रस्ताव न्याउनु भएकोमा अध्यक्ष कृष्णप्रसाद काफ्लेले यो विषयलाई हतार गर्न नहुने र यस सम्बन्धमा पहिले निर्वाचन गराएकै अनुभव प्राप्त व्यक्तिहरूको एक कमिटि बनाई उहाँहरूको राय-सल्लाह अर्को साधारण सभामा पेश गराई छलफल गराउने निर्णय भयो ।
- भू-विज्ञानको क्षेत्रमा छात्रवृत्तिको व्यवस्था गर्न राम्रो हुन्छ कि भन्ने अच्युतानन्द भण्डारीको प्रस्तावमा छलफल हुँदा उक्त छात्रवृत्ति ने.भौ.स.ले व्यवस्था गर्नेगरी कुनै व्यक्ति विशेष वा संस्थाले कोष खडा गरिदिनेमा के-कसरी व्यवस्था मिलाउने हो सो बारे का.का.स.ले प्रस्ताव न्याउने निर्णय भयो ।
- साधारण सभाले Rules and Regulations Sub-Committee का संयोजक श्री अच्युतानन्द भण्डारीलाई विधान संशोधनको लागि राम्रो काम गर्नुभएकोमा धन्यवाद प्रस्ताव पारित गर्‍यो ।
- कृष्णमुरारी अमात्यले भित्रराष्ट्र चीनको तिब्बत क्षेत्रका भू-वैज्ञानिकहरूले NGS सँग मिलेर केही भौगर्भिक अध्ययनहरू गर्न चाहेकोकुरा सभामा अवगत गराउनु भयो ।
- अध्यक्ष कृष्णप्रसाद काफ्लेले NGS का सदस्यहरूले AGID तथा IABG को सदस्यता लिन चाहेमा NGS मार्फत आवश्यक प्रकृया पुर्‍याई लिन सक्ने व्यवस्था का.का.स.ले मिलाएको कुरा जानकारी गराउनु भयो ।
- श्री विनोदसिंह क्षेत्रीले NGS को कार्यालय कहाँ छ भनी अध्यक्षलाई प्रश्न गर्नुभएकोमा अध्यक्ष श्री कृष्णप्रसाद काफ्लेले हाललाई NGS को कार्यालय खानी तथा भूगर्भ विभागको कम्पाउण्डभित्र एक कोठामा सञ्चालन भइरहेको र सोको लागि एवं Geoscience Library स्थापना गर्नको लागि खानी तथा भूगर्भ विभागको कम्पाउण्डभित्र जग्गा उपलब्ध गराउने सम्बन्धमा मन्त्रालयस्तरमा कुरा पुगेको र फाइल अगाडि बढिरहेको कुरा जानकारी गराउनु भयो ।
- सभाको अन्त्यमा यस सभाका सभापति एवं ने.भौ.स.का अध्यक्ष श्री कृष्णप्रसाद काफ्लेले यस सभामा सहभागी भई छलफलमा सकृयताकासाथ भाग लिनुभएकोमा सम्पूर्ण सदस्यज्यूहरूलाई धन्यवाद ज्ञापन गर्दै सोहि दिन साँझ ६:०० बजे उक्त स्थानमै पुनः Biennial Function (द्व्यवर्षिकी समारोह) मा सहभागी हुन आमन्त्रण गर्दै सत्रौं साधारण सभा विसर्जन गर्नुभयो ।

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## Best Wishes and Hearty Felicitations on the auspicious occasion of 47th Anniversary of National Democracy Day

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## नेपाल भौगर्भिक समाजको आठौं द्व्यवार्षिकी समारोह

अगस्त ३०, १९९६ - काठमाडौं, नेपाल

नेपाल भौगर्भिक समाजले आयोजना गरेको आठौं द्व्यवार्षिकी समारोह माननीय उद्योग राज्य मन्त्री श्री दुष्मिन् राज शास्त्रीजीको प्रमुख आतिथ्यमा होटल हिमालयको सभाकक्षमा सुसम्पन्न भयो। उक्त समारोहमा विभिन्न मन्त्रालय, विभाग, कार्यालय, विश्वविद्यालय एवं स्वदेशी तथा विदेशी

सहयोग संस्थाका उच्चस्तरीय पदाधिकारीहरूको सहभागिता रहेको थियो। उक्त समारोह उद्योग मन्त्रालयका सचिव डा. श्री भोलानाथ चालिसेको सभापतित्वमा भएको थियो। सो समारोहमा समाजका अध्यक्षको स्वागत भाषण र नवनिर्वाचित अध्यक्षको मन्तव्य तल प्रस्तुत गरिएका छन्।

### Welcome speech by Mr. K. P. Kaphle, President, on the 8th Biennial Function of Nepal Geological Society

Honourable Chairman

Honourable Chief Guest, Minister of Industry

Mr. Dhundi Raj Shastri

Secretaries and Senior officials of His Majesty's Government, Nepal

Mr. William Berger, Co-ordinator, Disaster Management Secretariat, UNDP/Nepal

Mr. Todd Stowell, Project Co-ordinator, Disaster Preparedness Project, Lutheran World Service/ Nepal

Presidents of Previous Executive Committees of Nepal Geological Society

Dr. C.K. Sharma, Honorary Member of NGS

Distinguished guests, and Fellow Members of Nepal Geological Society

Ladies and Gentlemen

On behalf of the Nepal Geological Society (NGS) I welcome you all to this 8th Biennial Function of the Society. We are extremely grateful to our chief guest, Honourable Minister of Industry, Mr. Dhundi Raj Shastri, who gladly accepted our invitation to grace this function and to be with us this evening in spite of his busy schedule.

This function is one of the non-technical activities of NGS which takes place once in every two years. It is also an important occasion when the newly elected members of NGS Executive Committee take their oath of office in the presence of our distinguished guests, and members of NGS. This is also a time when reviews on the achievements made by the Society during the previous two years are made. New office bearers present their future programmes and plans for their tenure of office.

Nepal Geological Society has completed its 16 years of its establishment. It is an active professional scientific society with over 375 geoscientists from Nepal and abroad. We are proud to mention here that many of the members of NGS are well known Himalayan geoscientists who have dedicated decades of their life to the scientific researches in the Himalayas.

Nepal Geological Society has made remarkable achievements in the preceding years in fulfilling its objectives and carrying out various activities which have greatly helped in the development of geological science in Nepal. The society is also gradually gaining regional and international importance in networking geoscientists working in the Hindukush-Himalaya-Karakorum-Tibet regions. The organization of the International Seminar on Hydrology with special Colloquium on Environmental Problems and Water Resources of the Himalayan Region in 1993, the International 9th Himalaya - Karakoram - Tibet Workshop in 1994, and publishing the proceedings of the workshop in time, has established the credibility of the society and has been greatly appreciated by the international geoscientific community. To observe the 15th anniversary of the society, the First Nepal Geological Congress was also organized in Kathmandu in August 1995. All these scientific meetings and seminars have provided opportunities to our geoscientists for shearing of knowledge, experience and ideas with their counterparts from different countries across the continents. The abstracts of the papers presented in the congress were published in the Journal of Nepal Geological Society, Volume 12 (Special

Issue). We are determined to bring out the proceedings of the congress by the end of this year. We hope that the momentum gained by the society in the past few years will go further ahead in the years to come.

Nepal Geological Society has been observing the IDNDR-Day since 1991. In close cooperation with the Ministry of Home, Water Induced Disaster Prevention Technical Centre (DPTC) and UNDP/Nepal, NGS successfully organized one-day meeting cum seminars to observe the IDNDR day also this year. The Resolutions adopted at the IDNDR Day meetings are forwarded to His Majesty's Government and international organisations. Abstracts of the papers presented during the seminar are published in the Bulletin of the Nepal Geological Society.

The Society invited Professor P.G. Cooray, a well known geoscientist of Sri Lanka, to conduct the *Scientific Writing Workshop* in Kathmandu in September 1995. The Workshop was attended by 45 participants (geologists, mining engineers, geomorphologists, engineers, managers, planners, and researchers) from various government organizations, Tribhuvan University, consulting firms and international organisations. The Society also organized several scientific talk programs on various themes.

Regular publication of journals is perhaps the most important activity of a professional scientific society. Our society has so far been able to publish its Journals and News Bulletin on a regular basis. May I remind here that the society brings out two publications: (i) the Journal of Nepal Geological Society and (ii) the News Bulletin. The former includes only scientific research papers while the other, in addition to the information on the activities of the Society, carries popular articles related to the geology of the Himalaya. During the past 2 years, it has published the proceedings of the 9th Himalaya-Karakorum-Tibet workshop (Volume 11, Special Issue), the Abstract Volume of First Nepal Geological Congress (Volume 12, Special Issue), and other regular issues of the journal (Volume 10 and 13). Similarly, the News Bulletins (Volumes 12 and 13) are already in circulation. In addition to these publications, the NGS Member's Directory was also published in August 1995.

Distinguished guests, Nepal lies in a seismically active zone. It has experienced many great earthquakes in the past. Out of these earthquake disasters of 1934, 1960 and 1988 are still in our living memory. We the geoscientists feel that it is our responsibility to make the common people aware of the possible mitigations against earthquake disaster. NGS believes that effective reduction of disaster cannot be achieved without active and convinced participation of the common people. Keeping this in view NGS in cooperation with the National Society for Earthquake Technology Nepal (NSET) decided to publish an earthquake disaster awareness booklet entitled "भूकम्पको निवारणबाट कसरी जोगिने" for wider distribution in the schools, villages and towns throughout the country. This booklet can also be used as a training manual. In this endeavor, we were supported by the Disaster Preparedness Project, Lutheran World Service, Nepal by providing the necessary funds for publication. We are thankful to Mr. Todd Stowell, Project coordinator of for his helps. The Society is also thankful to the contributors, Mr. Amod Mani Dixit, coordinator, NGS IDNDR Council and Mr. Mahesh Nakarmi, members, NGS and NSET Nepal, who not only prepared the manuscript but also contributed actively in the preparation of the cartoons and publication of the booklet. This booklet will be released after few minutes by our chief guest Hon. Minister of Industry, Mr. Dhundi Raj Shastri. We also hope that the Government will implement the National Building Code prepared by the Department of Building as soon as possible, which will become the most important action for increased seismic safety in Nepal.

The Society has always received unconditional support and contributions from its members. I would like to bring to the kind notice to this august gathering that NGS is a non-profit organization and all its executive officers work on volunteer basis. The only paid staff is a peon who also works on a part-time basis. The Society's regular income is the membership fee and advertisements in the Bulletin. The scientific meetings and seminars are conducted from the registration fees received from the participants. The incomes and expenses are audited by registered auditors and the statements are published in the News Bulletin. I may stress here

that Nepal Geological Society is different from other Non Governmental Organizations (NGO) in Nepal. We do not have office bearers and advisors on our pay rolls. We do not receive any regular funds from donor institutions. Ours is a purely professional scientific society. Its objectives and activities are different than that of a trade union. For all these years, it has been a hard time to convince the government authorities on this point. We request the government that NGS be treated as a scientific society. It must have a separate status of a professional scientific society and be distinguished from the normal Non Governmental Organizations (NGO). Now that the Ministry of Science and Technology has been formed, we expect the ministry to take up this issue more seriously. The advancement of science and technology in a country cannot be realized without the active cooperation between the professional societies and the government.

Here, I would also like to point out some of the recent decisions of the government which are very painful to the Society. The society is in need of a small piece of land for its office building which will also be used for the Geoscience Library that we have created. We requested the Department of Mines and Geology to provide a small piece of land at a corner within its premise. The department and the Ministry of Industry both agreed to provide the land. However, the Finance Ministry has not consented on it. Most professional societies in the world, specially in developing countries, are provided with all types of supports - the physical, moral, organizational and financial. Nepal Bar Association has been given the land to construct its office building within the premises of the Supreme Court. We request to the government to provide the land to the NGS on a similar condition.

May I remind here that there is no place in the country where we can find a reasonably good collection of geoscientific literature. The Society has been able to build a significant collection of important and expensive geoscientific literature and journals published by various national and international scientific organisations, institutions and agencies. We have also a very good exchange programme with these institutions. The library is open to all the geoscientists.

Honourable Minister, We have raised the issue of representation of NGS in various

organisations and national committees such as IGCP, RONAST, Environment protection council, Tribhuvan University Academic Council and other relevant institutions. Similarly we also requested the Rt. Honourable Prime Minister and the Ministry of Population and Environment to provide openings for geoscientists in the new ministry. Without geological studies, the development works, such as construction of roads, dams, tunnels, environmental protection, natural disaster reduction etc. can not be properly done. Therefore, we request the Government to create necessary posts of geologists in the Department of Roads, the Water Induced Disaster Prevention Technical Centre (DPTC), the Electricity Development Centre, the Department of Soil Conservation and Watershed Management, the Ministry of Population and Environment, and in all the mineral-based industries

Dear members, whatever we could do in the last 2 years, it was only because of your help, cooperation, advises and criticism. Without your active cooperation and support it would have been impossible to organize the international seminars and meetings, publication of the Journals and Bulletins and raising funds. On behalf of the 8th Executive Committee, I would like to extend our heartfelt thanks to all of you for your help and cooperation. The 8th Executive Committee would also like to extend its sincere thanks to the national as well as expatriate consulting firms, mineral based industries, ICIMOD, UNDP/Nepal, Lutheran World Service, GTZ/BGR and RONAST for their financial support and the NPC, DMG, PEPP, GWDP, Department of Irrigation, NEA, EDC, Department of Geology, Tribhuvan University, for their constant moral as well as logistic supports.

I had the opportunity to work with a team of very sincere and hard-working members. I tried my best to fulfill the responsibility that was bestowed onto me. The shortcomings, obviously, are mine and I extend my apologies for the same.

Honourable Chief Guest and distinguished guests, your presence on this occasion has given the encouragement and moral support to the Nepalese geoscientists. We also look forward to your support in the future too.

I thank you very much for your attention and patience. □

## Speech by Dr. B.N. Upreti, President-Elect on the Occasion of the 8th Biennial Function of NGS

Mr. Chairman,  
The Chief Guest, Honourable Minister of Industry Mr. Dhundi Raj Shashtri  
Honourable Asst. Minister of Industry Mr. Gopalji Jung Shah,  
Mr. William Berger, Coordinator, Disaster Management Secretariat, UNDP, Nepal  
Mr. Todd Stowell, Project Coordinator, Disaster Preparedness Project, Lutheran World Service, Nepal  
Presidents of previous executive committees of Nepal Geological Society  
Distinguished guests  
Fellow members of the Nepal Geological Society  
Ladies and Gentlemen

It is indeed my great pleasure to extend a very warm welcome to all of you once again on behalf of the Nepal geological Society and on behalf of myself in this biennial function of the Society.

At the out set, let me allow to express my deep sense of appreciation to you all for kindly accepting our invitation and being with us here in this evening. Your kind presence here tonight has made us feel honoured. You have indeed made us feel that you care about our society, you truly believe on our endeavor in scientific pursuits and share our sentiments in helping the society in general through the development of the Geological Science.

Also, on behalf of all the members of the newly elected Executive Committee, may I take this opportunity to express our deep gratitude to all the members of the Nepal Geological Society for unanimously electing us to the ninth executive committee. We thank you once again from the bottom of our heart for giving us this opportunity to work for the society for the next two years. Let me assure you here that this newly elected team consists of dedicated members. I am sure they all will work sincerely to the best of their ability for the development of the society. At the same time, we are also very much expecting your constant guidance, valuable suggestions,

active participation and cooperation in all the future activities of the society.

Today, I am happy to say that we all are proud to be the member of the Nepal Geological Society. It is one of the foremost scientific society in the country. But, let us not forget that to bring this society to the present position, our ex-presidents, previous executive committees and each of our members, have worked very hard in all these years. I am sure you will join me to thank them all for their valuable contribution to the society. I also firmly believe that this spirit of dedication to the profession and to the society from all of its members will continue in the years to come.

We have progressed forward slowly but surely, step by step in building up the society. But, there is a lot more to be done. Ours is a small community as yet. We have many constraints, of which financial constraint is one of the very serious one. As you all know, we run our society only from the membership fees. Due to these constraints, the society is not able to carry out its activities to the extent we like to do.

Our society has come a long way. I believe, it would not be out of place to mention here some of our bitter experiences of the past. We have found that, normally our voice on matters of national interest and issues which can affect a large number of our common people is not seriously considered by the government. This indifference and lack of seriousness shown by the government on the views and suggestions of a professional society on matters of national interest is a matter of great concern. We are here to work for the country, for the society and ready to extend our helping hands to the government in the field of our expertise and experience. The Nepal Geological Society was born for this noble cause. It is not a trade union, as many of our government officials think. It is not a NGO of a type that are mushrooming day by day in Nepal. I want to stress here that it is purely a scientific society. It is a

professional Society run by responsible scientists of the country, and the country can greatly benefit from the services it can render.

Since many years, we have been approaching the Ministry of construction and Transport, Department of Roads to employ a few geologists to take care of the engineering geological work of the department. No other country can think of such a department without the service of geologists. The Roads Department very well knows the importance of geological studies for survey, design, construction and maintenance of roads in a mountainous country like Nepal. The country can save a huge amount of money in a better survey, design and construction of roads. In a department where hundreds of engineers and overseers and many more number of non-technical personnel are employed, there is no reason why a couple of geologists could not be accommodated. It is a gross negligence on a matter of national interest on the part of the responsible authorities. I once again appeal to the concerned authorities to be more sensible on matters of such vital national interest.

Another example of lack of seriousness on the part of the authorities is reflected in the activities of the Water Induced Disaster Prevention Technical Centre (DPTC). An organization like DPTC working on landslide studies and stabilization, debris-flow, river training works and other form of water induced disasters has no geologists. It is like running a hospital without a doctor. The society has repeatedly approached DPTC about this matter. But they are yet to favorably responded to it. I think this is an opportunity to appeal once again to DPTC on behalf of the Nepal Geological Society to take up this matter more seriously.

Department of Soil Conservation is another government organization where similar lack of seriousness has been felt. The society has repeatedly stressed to the authorities about the necessity of geological input in fulfilling the basic objectives of this department. The department is expected to be a multidisciplinary department, and one of the fundamental component naturally has to be the *Geology*. The irony is, the department

studies and stabilizes landslides, works on soil erosion studies and control and other slope failure phenomena without a geoscientist. We can not afford to continue this kind of activities by the department any longer. We request to the concerned ministry and the department to take this matter seriously and take service of at least one geologist in each district branch of the department as soon as possible.

Recently, the society also felt a similar unresponsive attitude of the concerned authorities in the government during the formulation of the organizational structure of the newly constituted Ministry of Population and Environment. The society approached in writing to the Rt. Honourable Prime Minister, the respective Minister, the Vice-Chairman of the National Planning Commission and the concerned Secretary of the Ministry much in advance and explained the important role of geoscience in the study of environment, and requested to create appropriate number of posts of geologists in the ministry. Despite the assurances given, the ministry finally has not created any position for geologists. The geologists who are central to the studies and management of the environmental problems, have been completely left out. The Nepal Geological Society requests once again to take necessary action to create some posts of geologist in the ministry.

Honourable Minister, if Nepal can be proud of its industries, it is only the mineral based industries that can be counted. The revenue from these industries is unmatched. To prove a limestone reserve for a cement factory, a geologist works for years in the most difficult environment, many times risking his life. The whole project rests on the technical capability and judgment of the geologist. But once the factory comes up and production starts, the geologist is forgotten. The geologist has a vital role also to run the industry smoothly. For example, our cement industries were forced to stop their production many times in the past due to the inadequate support of a geologist, the quality seriously often deteriorates due to inadequate quality control. But despite our repeated requests, no geologists have been employed in these

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industries so far. Similar case is with the Orind Magnesite mine. On behalf of the Nepal Geological Society, I request to the Honourable Minister to look into this matter seriously.

The Department of Mines and Geology is the only government organization which is responsible to carry out geological mapping, mineral exploration and promotion of mineral based industries. In recent years, its role is expanding in the field of engineering and environmental geology, seismic studies of the Himalaya and in the study and management of natural disasters. Looking at the expanding role of the department, it is time to establish its regional offices to run its activities more effectively. By this, it can provide the needed services in the development activities of the region and the people can get the timely services in study and management of natural disasters.

Mr. K.P. Kaphle, the President of the Nepal Geological Society has already highlighted the past activities carried out by the society. Now let me outline the future programmes that the society would like to take up. It may be grouped into two categories: (1) the continuation of the ongoing regular programmes and (2) new programmes. About the ongoing programmes, the society will continue its effort to publish the Journal of Nepal Geological Society and the News Bulletin in time. The society will also try to publish the proceedings of the first Nepal Geological Congress as early as possible. The society will continue to observe the IDNDR day and organize workshop on the occasion in collaboration with the Ministry of Home, DPTC and the UNDP as in previous years. We would continue to organize the scientific talk programmes more frequently. The last scientific writing workshop organized in Kathmandu by the Nepal Geological Society with the financial support from the AGID was a great success. Many of our members who could not take part in this programme have requested us to conduct the training once again. The Society has already approached AGID and Professor P.G. Cooray for conducting a

second workshop in Kathmandu. Similarly, the society will explore possibilities to conduct other kind of professional training to our fellow members.

The society will also continue its effort to acquire land for the office building and the Geoscience library of the society.

Nepal Geological Society has already decided to organize geological congress on a regular basis. It has already successfully organized the first Nepal Geological Congress in 1995. The ninth executive committee of NGS is planning to organize the second geological congress in the later part of 1997. We hope that the Government organizations, national and international agencies, mineral based industries and engineering and geotechnical consulting firms will continue their support as in the past.

The geoscientists of the SAARC countries have decided to organize regular geological congress in the region with a view to exchange information and research findings among them. Accordingly, the first South Asia Geological Congress (GEOSAS) was organized in 1992. The second congress was held in Sri Lanka in 1995. The third is going to be held in Bangladesh in 1998. Now this is the time to think about organizing the GEOSAS IV in Nepal in 2001. All these previous South Asia Geological Congresses were organized by the respective governments in cooperation with the geological societies and the universities. Therefore, we request our government to constitute the organizing committee and plan for the financial and technical arrangements in time. Honourable Minister, I can assure that the Nepal geological Society is capable to take the responsibility to manage the technical part of the congress. In the coming GEOSAS II meeting in Bangladesh, we request His Majesty's Government to propose to host the GEOSAS IV in Nepal.

Before I close, once again I would like to express my heartfelt thankfulness to you all and hope to get your constant help and cooperation for the success of our future activities.

Thank you.

□

## Vote of Thanks by Mr. D.N. Subedi, Secretary-Elect, NGS

Respected Chairman,  
Honourable Chief Guest, Minister for  
Industry, Mr. Dhundi Raj Shastri,  
Honourable Ministers,  
Distinguished Guests,  
Dear Members of the Society,  
Ladies and Gentlemen !

It is indeed a privilege for me to have this opportunity to give the vote of thanks. On behalf of the Nepal Geological Society, I take this opportunity to thank first of all to our honourable Chief Guest, Minister for Industry Mr. Dhundi Raj Shastri for kindly accepting our invitation to be the chief guest in this biennial function of the Nepal Geological Society. We are grateful to him for being with us in this evening and releasing the booklet on the earthquake disaster preparedness.

The Society is highly grateful to Mr. Todd Stowell, Project coordinator, Disaster Preparedness Project, Luthran World Service who willingly came forward to financially support the publication of the Disaster Awareness Booklet entitled "Bhukampa Ko Binas Bata Kasari Jogine".

I would also like to express our sincere thanks to all the officials of His Majesty's Government of Nepal, distinguished guests from various national and international agencies and journalists who kindly accepted our invitation and spared their valuable time with us this evening.

It is my pleasure to express our sincere thanks to all the members of the Nepal Geological Society for their help and co-operation extended to the Society whenever it was required. We also highly appreciate their enthusiasm, seriousness and active participation in the activities of the society.

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new executive committee has formed the following sub-committees from among its members.

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## **International Decade for Natural Disaster Reduction IDNDR-Day, October 9, 1996**

### **National Meeting cum Seminar on "Understanding our Physical Environment: Key to Natural Disaster Reduction".**

The Nepal Geological Society, as in the past, organized a one-day National Meeting cum Seminar on "Understanding Our Physical Environment: Key to Natural Disaster Reduction" in Kathmandu in collaboration with National Committee for IDNDR Nepal and UNDP/Nepal. The United Nations has declared the 1990-2000 as the International Decade for Natural Disaster Reduction. Second Wednesday of October is observed as the IDNDR-Day. The Nepal Geological Society has responded the UN declaration since 1991 by organizing one day National Meeting cum Seminar every year and this is the continuity of this tradition.

The Inaugural Session was chaired by Mr. Bekha Ratna Shakya, Mayor, Lalitpur Municipality. Honourable Assistant Home Minister Mr. D.P. Baskota was the Chief Guest.

Dr. B.N. Upreti, President, Nepal Geological Society, delivered the welcome speech. The Chief Guest, Honourable Asstt. Minister of Home inaugurated the Meeting

cum Seminar and addressed the gathering. Mr. A.M. Dixit, Coordinator, NGS/IDNDR Council highlighted on the IDNDR concept. The meeting was also addressed by Mr P.L. Singh, Mayor of Kathmandu Municipality, Mr. W. Berger, Coordinator, Disaster Management Secretariat, UNDP, Nepal, Mr. G.S. Thapa, Director General, DMG and Mr. M. Poudel, Project Director DPTC. The inaugural session was followed by two Technical Sessions. It was attended by over 250 persons from different national and international organizations and agencies based at Kathmandu. During this session 12 working papers on various aspects related to natural and manmade disasters were presented and discussed. At the concluding session a resolution was adopted from the participants and later submitted to the His Majesty's Government and other related national and international organizations. Some of the speeches, abstracts of the papers and resolutions are presented below.

### **Speech delivered by the Honorable Assistant Home Minister, Mr. D.P. Baskota**

Mr. Chairman,

It is a privilege for me to inaugurate this Meeting which has been organized as part of the National Program to observe the IDNDR Day, 1996. On behalf of the Nepal National Committee for the International Decade for Natural Disaster Reduction, I extend my

heartfelt thanks to the Nepal Geological Society for taking initiatives to organize this meeting cum seminar on this occasion. I am extremely glad to note that the Nepal Geological Society has made it a tradition to observe this important international date this way by inviting to discuss ways and means to increase national capability towards reduction

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of natural disasters. I attach much importance to this annual meeting because it gives us the possibility to look in retrospect what the government and all other institutions working in the field have done towards achieving the noble goals of IDNDR. Observance of this day in this fashion makes us belong to the wider international community because such meetings and activities are being carried out throughout the world today.

As it is well known, Nepal faces several kinds of natural disaster. This is one of the countries lying in an earthquake prone part of the globe. The country faces recurrent problems of landslides, floods, debris flows, erosion, cloudburst and cyclonic storms, droughts, etc., which are of natural origin. There are also other disasters which stem out due largely to our own actions. Due to the scale of the problems faced, and the limited resources with the country, it may look that we are mostly pre-occupied with the tasks of post-disaster activities such as rescue and response, relief and rehabilitation. However, we have understood that prevention and mitigation activities are the most effective in reducing the disaster and its management. This is also the central theme of the IDNDR concept.

The Nepal National Committee for the IDNDR has been promoting this idea and philosophy. The Committee has developed the National Action Plan for IDNDR with this perspective to get the whole country prepared for natural disasters. The National Action Plan is going into implementation gradually. Necessary steps are being taken to incorporate the disaster management aspect into the national planning process. At the same time, this plan incorporates all the activities undertaken by the government and other institutions in different aspects of disaster management in the country. This way the Action Plan has

become an important tool for the coordination of the national efforts towards reduction of disasters and their impact in the country.

His Majesty's Government of Nepal is committed to the IDNDR concept and undertakes all necessary actions as to achieve the overall goals of reducing the sufferings of the common Nepalese from the vagaries of the nature. However, it is well known that the Government alone can not do all the necessary work. The responsibility of disaster reduction should be shared by all section of the society.

I am happy to note that several non-governmental organizations have understood this and are working to the best of their resources and possibilities. And the initiatives taken by the Nepal Geological Society is really commendable.

Fulfillment of such tasks calls for the involvement of professionals and agencies from the government, universities, professional societies and the public at large. The government, acting as a facilitator, will provide assistance to achieve the required level of coordination of action.

There are many well trained scientists and engineers in the country. It is necessary to mobilize the knowledge of these personnel in the implementation of the tasks. At the same time, it is necessary to provide opportunities to the professional for access to information and knowledge acquired to that they are aware of the current knowledge worldwide in their respective fields.

I do hope that this meeting as well as the Seminar to follow will seriously discuss on these matters and come to a fruitful consensus regarding the necessary steps to be taken. The government will do its best to listen to the opinion of the scientists and implement the pertinent recommendations.

I thank the organizers again.

□

## **Welcome Speech by Dr. B.N. Upreti, President, Nepal Geological Society.**

Honourable Chairman, Mr. Bekha Ratna Shakya, Mayor, City of Lalitpur and President of Municipality Association of Nepal,  
Chief Guest Honourable Asst. Home Minister Mr. Deepak Prakash Baskota,  
Mr. William Berger, Coordinator, Disaster management Secretariat, UNDP/Nepal,  
Mr. Gopal Singh Thapa, Director General, Department of Mines and Geology,  
Mr. Madhusudan Poudel, Project Director, Water Induced Disaster Prevention Technical Centre (DPTC), Ministry of Water Resources,  
Distinguished Participants of the World Assembly of NGOs for Disaster reduction,  
Dr. C.K. Sharma, Honourable Member of Nepal Geological Society,  
Respected Secretaries and Senior Government officials of His Majesty's Government of Nepal,  
Distinguished guests,  
Dear fellow Members of Nepal Geological Society  
Ladies and Gentlemen,

On behalf of Nepal Geological Society and on my own, may I take this opportunity to extend a very warm welcome to you all this morning, and to thank you for kindly accepting our invitation to come to this programme. I am particularly thankful to the Honourable Asst. Home Minister for accepting our invitation to be our chief guest, here this morning to inaugurate the National Meeting cum Seminar on Understanding our Physical Environment: Key to Natural Disaster Reduction under the general UN theme for this year of 1996 "Cities at Risk", despite his extremely busy schedules.

I am happy to inform this august gathering that we have here in this inaugural programme the delegates of the World Assembly of NGOs for Disaster Reduction. I am extremely thankful to the delegates who very kindly accepted our invitation to attend this function. I wish your Assembly a grand success, and I hope you will have a pleasant stay at Kathmandu.

Today we are assembled here to observe the IDNDR-Day. It is observed every year on the second Wednesday of October. As we all know the decade of 90s that is 1990-2000 is declared

as the International Decade for Natural Disaster Reduction by the UN General Assembly in 1989. The main reason to declare the IDNDR Decade by the UN is the realisation of the scale and extent of the natural disasters that our world is facing every year. It is widely realised that, while many of the natural disasters can not be stopped, the awareness, preparedness and mitigative measures can greatly reduce the impact and save millions of lives, and property throughout the world.

Nepal Geological Society attaches great importance to the concept of IDNDR. It is obvious that geoscientists have a lead role to play in the understanding of the physical processes that bring about the natural disasters and in ways of finding mitigative measures. In case of the major kinds of natural disasters, whether it be an earthquake or landslide or flood or disasters due to volcanic eruptions, geoscientists make studies of the processes, their probable frequency of recurrences and suggest the possible measures so that a minimum loss of life and property is assured.

Nepal Geological Society has been observing the IDNDR-Day since the first year of the IDNDR Decade i.e. 1991. It has constituted a permanent council, the NGS- IDNDR Council responsible for IDNDR activities. I am happy to mention here that NGS in collaboration with Lutheran World Service/Nepal has published an awareness booklet on the earthquake disaster Preparedness which some of you may have already on your hand. The society is also going to organise a training programme on disaster preparedness to the school teachers and others on the occasion of the IDNDR-Day in few days time in collaboration with the Lutheran World Service/Nepal. The Society hopes to organise such training programmes on a regular basis in collaboration with various Government and non-Government organisations and UN agencies involved in disaster preparedness activities. Nepal Geological Society has the right professional background and its serious commitment in all activities of Natural Disaster reduction in Nepal. Realising this, We believe, His Majesty's Government of Nepal has included the Nepal Geological Society as a member in



the IDNDR National Committee. Honourable Minister, as a President of the Nepal Geological Society, I assures you that the Society will be ever ready to work together with the His Majesty's Government in all aspects of Natural Disaster Reduction.

The role of geoscience in natural disaster reduction and studies and management of environmental problems need not be emphasised here in this august gathering. As a professional Scientific society it is our duty to point out that in areas where earth-scientists could contribute to a great extent and sometimes even indispensable, such as in the newly formed Ministry of Environment, Ministry of works and transport and in many other government organisation, geo-scientists are not represented. We hope that such inconsistencies will be gradually overcome. This will undoubtedly save the country from unnecessary and costly consequences of disasters. Even today, in case of occurrences of natural disasters such as earthquakes, landslides, debris flows involving loss of lives and heavy damage to properties and infrastructures, geoscientists are not included in the early teams to visit the disaster sites. In most

instances, such visits by geoscientists are very essentials both from understanding the phenomenon of the disaster and for further safety of the affected people such as during a landslide disaster. We hope that in the future, the concerned agencies related to disaster mitigation, preparedness, and relief works will have their policies to take care about this point.

Due to its unique geological setting, Nepal is a highly disaster prone country. Whether it be earthquakes, landslides, debris flows, soil erosion, or flood, the ultimate cause is due to our existing physical environment. A better understanding of our physical environment is very essential in reducing the natural disasters. Therefore, the theme that we have proposed for this year's meeting is "Understanding our Physical Environment: Key to Natural Disaster Reduction". I hope the seminar, that will follow this meeting, will bring not only a better understanding of our physical environment but also a better understanding among various professionals and experts that are participating in the seminar.

Lastly, Once again I extend a very warm welcome to you all. And Thank you very much.

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## Speech by Mr. P.L Singh, Mayor, Kathmandu Municipality

Mr. Chairman,  
Honourable Assistant Home Minister, Mr. D.P.  
Baskota,  
Distinguished Participants,  
Ladies and Gentlemen,

I am pleased to be here with you this morning in this important meeting on "Understanding our Physical Environment: Key to Natural Disaster Reduction". I sincerely thank the organizer for giving me this opportunity to share my views with you.

I would like to bring your attention to the fact that cities in Nepal were built and developed in the past as safe and secure places for human habitat and human development. With rapid urbanization, unplanned and haphazard growth without any forethought of the implications of such growth, our cities are facing almost insurmountable problems and grave risks. In other words, with urbanization pressure and our failure to absorb the growing population in a planned way, our cities are increasingly threatened by natural disasters like flooding, earthquake, landslides, etc.

The sprawl growths within the Kathmandu Valley and location of buildings and

settlements on flood plains, riverbeds, steep slopes and vulnerable soils make Kathmandu less sustainable. Our motto of "Clean, Green and Healthy Kathmandu" attempts to visualize long term approaches for reminding us that further development should take place in a planned way to enable us to always being sensitive to the issue of carrying capacity. With increased awareness and participation of the local population only, their realization of nation's potentials and their necessary determined actions, development will be more linked with the mitigation of risks and people and communities will create risk-free habitats.

I am of the opinion that it is the local population and local authorities who deal with the problems related to disasters at the initial stages. I, therefore, urge the policy planners to incorporate the importance of the local authority and local populations on matters related to different aspects of disaster mitigation.

Before, closing, let me once again thank you all for your attention and wish you success of the seminar.

Thank you.

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### Geoscientific Writing Workshop

Nepal Geological Society (NGS) is happy to announce that a **Geoscientific Writing Workshop (Training)** is going to be organized from **16-18 November 1997** in collaboration with **AGID (Association of Geoscientists for International Development)** and **IUGS (International Union of Geosciences)**. The workshop will be conducted by Professor P.G. Cooray from Sri Lanka. This is the second time NGS is organizing this workshop.

The members of NGS as well as interested persons may contact President, **Dr. B.N. Upreti** C/O Department of Geology, Tribhuvan University, Tri-Chandra Campus, Ghantaghar [Tel.: 416386 (Res.)], or Secretary, **Mr. D.N. Subedi** C/O Department of Mines & Geology, Lainchaur [Tel.: 411396 (Off.), 274788 (Res.)] for further details. Only 30 persons will be admitted in the workshop. The admission will be on the first come first serve basis.

## **Vote of thanks by D.N. Subedi, Secretary, NGS**

Respected Chairman,  
Chief Guest, Honorable Asst. Home Minister,  
Mr. Deepak Prakash Baskota,  
Respected Secretaries of different ministries of  
HMG/Nepal,  
Distinguished Guests and Participants,  
Dear Fellow Members of the Society,  
Ladies and Gentlemen !

On behalf of the Nepal Geological Society, I welcome you all once again to today's National Meeting cum Seminar on "Understanding Our Physical Environment: Key to Natural Disaster Reduction" under the general theme proposed by United Nations for this year "Cities at Risk". Since 1990 the Nepal Geological Society is contributing to Natural Disaster Reduction Programmes in Nepal in close cooperation with IDNDR National Committee Nepal, DPTC, UNDP/Nepal and other governmental and non-governmental organizations and agencies.

The Society is very grateful to our chief guest, Honorable Asst. Home Minister, Mr. Deepak Prakash Baskota for giving his valuable time to be with us this morning to inaugurate the meeting cum seminar and for the inaugural speech to this programme.

The Society would like to express its sincere gratitude to Mr. Bekha Ratna Shakya, Mayor, Lalitpur Sub-Municipal Corporation and President, Municipality Association of Nepal for presiding over this inaugural session as the Chairman and for his notable address to this session.

The Society likes to extend its sincere gratitude to Mr. William Berger, Coordinator, Disaster Management Secretariat, UNDP/Nepal, for being with us and for your notable address and support for this programme.

The Society has always received a very strong co-operation and support from the IDNDR National Committee, Nepal. The Nepal Geological Society extends its sincere thanks to the IDNDR National Committee, Nepal for their support and cooperation and for the financial

help to organize today's meeting cum seminar.

I would also like to take this opportunity to acknowledge the help and cooperation from DPTC, Ministry of Water Resources for their cooperation and providing financial support to organize this programme.

The Nepal Geological Society would also like to extend its sincere gratitude to all the high officials of His Majesty's Government of Nepal, distinguished guests, journalists and other distinguished personalities for being with us in this inaugural ceremony.

The organisation of today's technical sessions to be followed after this meeting would not have been possible without the valuable contributions of papers by the distinguished experts. The Nepal Geological Society extends its heartfelt thanks to all the contributors and participants.

Various governmental and non-governmental organizations and agencies helped the society in different aspects in the organisation of this meeting cum seminar. Sincere thanks are due to the IDNDR National Committee, Ministry of Home, Department of Mines and Geology (DMG), Petroleum Exploration Promotion Project (PEPP), Groundwater Resources Development Board of Department of Irrigation, Nepal Electricity Development Center, Nepal Electricity Authority, Central Department of Geology/, Tribhuvan University and, Department of Geology, Trichandra Campus for their various supports extended to the society.

Our sincere thanks are also due to the Nepal Administrative Staff College (NASC), for providing this venue for today's meeting.

Last but not least, we are thankful to our fellow members whose continuous encouragement and support has made all this possible.

We offer our sincere apologies for any shortcoming or inconveniences that may have arisen during the organisation of this programme.

Thank you all once again !

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## Resolution adopted during the IDNDR Day, October 9, 1996

संयुक्त राष्ट्र संघको आह्वानमा यो वर्ष १९९६ अक्टोबर ९ का दिन IDNDR-Day 1996 मनाउन गृह मन्त्रालय, IDNDR National Committee Nepal, संयुक्त राष्ट्र संघ नेपाल, जलउत्पन्न प्रकोप नियन्त्रण प्रविधिक केन्द्र (DPTC) को सहयोगमा नेपाल भौगर्भिक समाजद्वारा आयोजना गरिएका "Understanding Our Physical Environment: Key to Natural Disaster Reduction" विषयक विचार गोष्ठी तथा सेमिनारका सहभागिहरूद्वारा पारित प्रस्ताव ।

यो सभा IDNDR-Day 1996 का दिन निम्न पारित गर्दछ ।

- (१) गत वर्षहरूमा आयोजना गरिएका IDNDR-Day 1994 तथा 1995 को सभाले पारित गरी श्री ५ को सरकारका विभिन्न निकायहरूमा पठाएका सम्पूर्ण प्रस्तावहरूलाई कार्यान्वयन गर्न सम्बन्धित निकायहरू समक्ष यो सभा पुनः अनुरोध गर्दछ ।
- (२) प्राकृतिक प्रकोप न्यूनिकरणका लागि IDNDR-National Committee Nepal द्वारा तयार पारिएको नीति, कार्यक्रम र राष्ट्रिय कार्ययोजना (National Action Plan) तथा मुलुकको लागि तर्जुमा गरिएको राष्ट्रिय भवन निर्माण संहिता (National Building Code) पूर्णरूपमा कार्यान्वयनमा ल्याउन श्री ५ को सरकार समक्ष पुनः एक पटक अनुरोध गर्दछ ।
- (३) संयुक्त राष्ट्र संघले यो वर्षको लागि निर्धारण गरेको नारा "Cities at Risk" को सन्दर्भमा जनसंख्याको अत्यधिक चाप भएका शहरीक्षेत्रमा खानेपानी, ढल निकास, Waste Disposal को समुचित व्यवस्था हुन र सवारी साधनहरूबाट पर्याकिने विषाक्त धुँवा, उद्योगहरूबाट निस्कने धुलो, धुँवा र रसायनिक पदार्थ इत्यादिबाट पानी तथा हावा प्रदूषण भई नगरवासीको स्वास्थ्यमा प्रतिकूल असर पर्न नदिन यथाशिघ्र सो को समुचित व्यवस्था मिलाउन सम्बन्धित निकायहरूसँग अनुरोध गर्दछ ।
- (४) समय समयमा बाढी तथा पैडोबाट क्षति ग्रस्त भएका मकवानपुरको फेदी गाउँ र कतिपय तराई क्षेत्रमा घटेका आगजनी तथा बाढी पैडो जस्ता घटनाबाट पिडित गाउँहरूलाई उदाहरण लिएर त्यस प्रकारका प्रकोप दोहोरिन सक्ने कुरालाई दृष्टिगत गरि उक्त प्रकोपहरूको रोकथाम तथा हुनसक्ने क्षतिको

न्यूनिकरण गर्न त्यस प्रकारका क्षेत्रहरूको पहिचान गरि समयमै आवश्यक उपायहरू अवलम्बन गर्न र पूर्व तयार रहन एवं पुनः स्थापनाको काममा बढीसँगै जन सहभागिता गराउन पनि यो सभा सम्बन्धित निकायहरू एवं श्री ५ को सरकार समक्ष अनुरोध गर्दछ ।

- (५) प्राकृतिक प्रकोप तथा मनुष्य जन्य प्रकोप के के हुन् ? तिनीहरू कति डरलाग्दा हुन्छन् र के कति धन जनको क्षति पुऱ्याउन सक्छन् भन्ने बारे तथा प्राकृतिक प्रकोप दैवी प्रकोप होइनन् ? तिनीहरूलाई मानिसहरूको कृयाकलापले कति असर पार्छन् र यस प्रकारका प्राकृतिक प्रकोपहरूलाई पूर्ण रोकथाम गर्न नसके पनि त्यसबाट हुन सक्ने क्षतिलाई कम गर्न सकिन्छ र सो को लागि प्रकोप आउनु अगावै के-के कुरामा ध्यान दिनु जरूरी छ र प्राकृतिक प्रकोप भइरहेका बेला तथा प्रकोप भएको लगत्तै पछि के के गर्नु पर्छ भन्ने जस्ता ज्ञान सर्व साधारण जनतासम्म पुऱ्याई उनीहरूलाई सजग गराउने खालका पुस्तिका तथा पोष्टरहरू विद्यालय र गा.वि.स. मार्फत गाउँ स्तरसम्म पुऱ्याएर तथा समय समयमा प्रवचन, गोष्ठी तथा तालिमको आयोजना संचालन गरेर जनतालाई सचेत गराउन पनि सम्बन्धित सबै निकायहरूलाई आग्रह गर्दछ ।
- (६) नेपालमा हुन सक्ने विभिन्न प्राकृतिक प्रकोपहरूको पहिचान गरि सोबाट हुन सक्ने क्षतिबाट बच्न पूर्व तयारी हुनका लागि Risk Assessment गरी मुलुकको Hazard map तथा Landuse map तयार गर्ने र एक Disaster scenario बनाई सोही अनुरूप कार्यक्रम संचालन गर्न श्री ५ को सरकारलाई अनुरोध गर्दछ ।
- (७) राष्ट्रिय विकासका कार्यहरू जस्तै खनिज उत्खनन तथा खनिजजन्य उद्योगहरूको स्थापना, मोटर बाटो, सुरुङ, बाँध, पुल, नहर इत्यादि निर्माण गर्दा, गराउँदा सोबाट हुनसक्ने वातावरण प्रदूषणलाई कम गर्नको लागि उक्त योजनाहरूको तर्जुमा गर्दा देखि कार्यान्वयनको समयसम्म विचार पुऱ्याई काम पूरा गर्न भूगर्भविद्, ईन्जिनियर, योजनाविद् तथा व्यवस्थापकहरू रहेको एक संयुक्त कार्यदल बनाई monitoring गर्ने र योजना पूरा भै सकेपछि पनि त्यस्ता संरचनाहरूको बचाउ गर्न पनि आवश्यक भएको कुरा यस सभाले ठहर गर्दछ ।

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## Abstracts of papers presented at the National Meeting cum Seminar on "Understanding Our Physical Environment: Key to Natural Disaster Reduction"

### Nature of the Debris Flow Disaster at Larcha, Upper Bhotekoshi, Sindhupalchok District

Li Tianchi<sup>1</sup>, D. P. Adhikari<sup>2</sup>, N. R. Khanal<sup>3</sup>, P. K. Mool<sup>1</sup>, K. B. Thapa<sup>4</sup> and Binod Shakya<sup>4</sup>

<sup>1</sup>International Center for Integrated Mountain Development (ICIMOD), Lalitpur, (Kathmandu),

<sup>2</sup>Department of Geology, Tribhuvan University, Tri-Chandra Campus, Ghantaghar, Kathmandu,

<sup>3</sup>Central Department of Geography, Tribhuvan University, Kirtipur, Kathmandu, Nepal

<sup>4</sup>Central Department of Meteorology, Tribhuvan University, Kirtipur, Kathmandu, Nepal

Bhairabkunda Khola, a mountain torrent, joins the Bhotekoshi River at Larcha nearby Km 109 of the Arniko Highway. The torrent drains a basin (25.25 km<sup>2</sup>) underlain by the Lesser Himalayan phyllite and the Higher Himalayan schist and gneiss. In the Larcha area, the foliation and schistosity dips 50° to the north. The torrent follows along the regional trend of the strike direction. The length of the main channel is 10 km and the average slope is 30%. The lower reaches of the basin (below 2000 m asl) is very steep as compared to the upper part. The catchment basin extending up to 4467 m has either unstable dip slopes mantled by discontinuous thick surficial deposit or vertical cliff. The lower slopes have extensive talus cones and relict colluvial veneers characterized by deep erosional gullies and slump scars. Rockfall chutes are common along the wall of the cliff and loose bouldery sagging mass blanket the torrent embankment below bedrock cliff. The Bhotekoshi valley is characterized by a chronically unstable slope composed of loose unconsolidated materials. In some places, the whole mountain appears moving down under the influence of toe cutting by the Bhotekoshi River.

The upland catchment area of the Bhairabkunda Khola has lost its forest cover due to clearing and overgrazing. As a result, enhanced peak discharge of the torrent scoured deeply into the surficial deposit and channel. On August 22, 1996, following 3 days of monsoon rains, the Larcha area experienced unprecedented catastrophic debris flow. The event completely erased 18 houses and killed 54 people. About 150 m road stretch and the bridge over the Bhairabkunda Khola were washed away.

Monsoon rains contributed to incipient instabilities on many dip slopes and the torrent undercutting further enhanced the instabilities along the torrent embankment. Major debris was generated from the surficial deposit of the mountain slopes and blocky embankment slumping. The bedrock failure at the notch of the first waterfall (WF1) probably blocked the flow of the torrent for the short time and the debris was mobilized from the side. The broken rock mass along the toe zone of the mountain became growing source of debris and potential for large bouldery debris flow. In any case, the lake might soon breached the narrow outlet and the surge of debris overwhelmed the small settlement along the Arniko Highway and mixed all into the Bhotekoshi River. According to the local Police Officer, the Larcha area experienced threatening noise from the bouncing of boulders and ground shaking as if it was stricken by strong earthquake during the disaster.

As the debris flow approached the bridge site, it completely plugged the bridge opening with a number of huge rock slabs of phyllite measuring up to 10.6 m x 6.8 m x 6.6 m (447 m<sup>3</sup>). The depositional features, internal structure and texture of debris indicate that the bridge was not collapsed at the first impact of debris mass.

Roughly 106,800 m<sup>3</sup> coarse debris spread over 400 m covering an area of 26,000 m<sup>2</sup>. The maximum width of the fan is 150 m and the slope is 10°. The highest flood level (HFL) as indicated by the muddy mark on the valley wall was about 7 m high from the then (18 August, 1996) actively eroding the Bhairabkunda Khola channel. On the other hand, the total volume of the materials up to the HFL was estimated to be

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- Feasibility studies of small hydro-power projects at many different places, e.g., Okhaldhunga-Rumjatar, Ramechhap, Sindhulimarhi and Udaypur Galghat-Bokse for Sami Hydel Development Board.
- Feasibility study of Mulghat hydro-electric project (68 MW) in collaboration with Electrowatt Engineering Services, Switzerland.
- Detailed feasibility studies of mini-micro hydro power project in Kagbeni-Mukdinath in Mustang district and Pakhapani in Myagdi district.
- Detailed design of small hydroelectric projects in Rawa (Khotang) and Dharam Khola (Baglung).
- Site investigation for feasibility study of Puwa Khola Hydroelectric project (6,200 kW) in association with Chuo Kaihatsu Corporation for JICA.
- Consultancy/advisory services in project preparation and design, in acquiring the development license, in preparation and negotiation of power project agreement for private sector financing such as Modi Khola HEP (14 MW) and Upper Bhote Koshi HEP (335 MW).
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175,200 m<sup>3</sup>. It indicates that the fan occupy about 60% of the total volume of the channel.

The debris deposit is characterized by frontal, central and upper fan segment based on the petrographic composition and size of the individual fragments. The frontal fan segment made up of huge blocks of phyllite dipping downstream direction. The average thickness is about 7 m and extends over 80 m. The central fan segment is composed of bouldery materials predominantly of phyllite mixed with schist and gneiss dipping downstream. It is about 180 m long and the average thickness is 3 m. The upper fan segment is also bouldery but individual fragments are intermediate in size between the frontal and central segment. It is about 140 m long and 2 m thick consisting almost equal amount of schist, gneiss and phyllite fragments.

A few gneiss boulders on the surface may be just reworked materials of the old river channel. The petrographic composition of the debris materials suggests that most of the materials are derived from the Lesser Himalaya and ruled out the possibility of GLOF. The ring-counting on tree trunk deposited on the fan yield the age of 60 years, which probably indicates the recurrence interval.

The basin is ungauged and precipitation data are unavailable making discharge estimation very difficult. The overnight event raised the Bhote Koshi River bed by about 60 cm at Barabise according to the local people. If there was no Larcha Bridge over Bhairab Kunda Khola there would have more serious destruction in downstream section particularly in Barabise area than as it happened at Larcha.

### **A Study on Flood Disaster and Appropriate Mitigation Method in Nepal**

**G.R. Joshi, P. Thapa and T. Wakai**

*Technology Development Division,*

*Water Induced Disaster Prevention Technical Center (DPTC),*

*Pulchowk, Lalitpur, Nepal*

Due to the varied topography, snow covered mountain and fragile geology, Nepal is suffering from water induced disasters. Due to the intensive rainfall during every monsoon season, deforestation, deposition of sediment in the river, every river in Terai has a problem of flood.

In order to mitigate the disaster of river, Disaster Prevention Technical Centre (DPTC) selected the model site for river training work with the view of developing suitable technology

The purpose of this paper was to analyse the disaster situation in Terai area and evaluate the model construction work which we are doing in order to establish the appropriate technology in Nepal. Firstly, the recent disaster situation in the Terai area, its reason and countermeasure are presented. Next, the new trial construction method at the model site and its effect are mentioned.

### **Threat to Cities of Nepal from Man-made Disasters**

**Kishore Shakya**

*Ministry of Population and Environment, Singh Durbar, Kathmandu, Nepal*

The natural calamities such as earthquake, volcanic eruptions, floods and land slides result in the devastation of natural resources and high casualty. Such events, in most cases, are beyond the control of human beings. In spite of intervention with technical and socio-economic tools, as well as environmental conservation efforts, it is the reality that man has not been fully successful in controlling the outcome of these disasters.

Generally, cities suffer quite often from man made disasters of serious nature. There are many instances when urban inhabitants have been the

victims of epidemics such as cholera, plague and leakage of high risk radio active substances from nuclear facilities. The Bhopal Tragedy and plague epidemic in Surat, India, and the nuclear disaster of Chernobyl in the former Soviet Union are some of the recent events that shocked the whole world. These are the large scale man made disasters which resulted in the death of hundreds of people, disablement and loss of property, as well as long lasting environmental deterioration.

The urban areas of developing countries like Nepal are exposed to a wide variety of man made hazards resulting from poor drinking water

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quality, air and industrial pollution, mishandling of solid waste disposal including hazardous waste, poor sanitation, improper human waste disposal system and overall deteriorating environment. Due to the diarrhoeal diseases alone, every year more than 45,000 children die in Nepal, and more than 75% of the cases are the result of poor quality water and inadequate sanitation.

High population influx in cities and the resulting unplanned settlements and development of slum areas is a critical problem in developing countries. The adverse impact of these man made problems in urban areas in health have to be critically examined and necessary actions must be taken in time. If serious measures are not taken to solve these problems, it is imperative that urban people of Nepal would face disasters similar to that of Surat Plague and wide spread Cholera epidemics. At present, the situation on the environmental

deterioration of Kathmandu city has reached to such an alarming level that it may be regarded as serious as a large scale natural disaster. Though not obvious at the first glance, the inhabitants of the city of Kathmandu are under serious threat due to multiple aspects of environmental pollution and sanitation. In the days to come, other cities like Biratnagar, Pokhara and Birgunj will also be under similar situation like that of Kathmandu, if proper and timely adequate attention is not given to understand and solve the problems encountered.

A strong commitment from all corners of the society is deemed necessary to overcome these existing problems to ensure healthy environment of the cities. A more holistic approach should be taken in this regard to ensure a better health of the people, and thus establish an environment for sustainable economic growth of the country.

### **Slope Failure in Soft Soil: An Example of Santi Basti, Lalitpur, Kathmandu Valley**

**A. Koirala, V.B. Shrestha and U.B. Shrestha**

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A paleo-lake valley, Kathmandu is full of various geotechnical problems. Many of them are unnoticed, others come in the media when it is too late to be corrected as the case of Santi Basti, while still others is yet to be realized. There can be a long list of problems which needs due recognition and immediate action required to mitigate the potential hazards posed by them to the inhabitants of the valley.

Few days before and after the widespread media coverage of the disaster caused by the slope failure of Santi Basti, the area was visited to investigate the causes, and effects of the event and to suggest the remedial measures to safeguard the slope failure.

Among the causes identified for the slope failure of Santi Basti are:

- 1) Saturation of the area by continuous rainfall.
- 2) Extraction of the sand from the river bed (Bagmati River) which was acting as a toe support of the slope.
- 3) Disturbance of the natural drainage system of the area without providing proper drainage system.
- 4) Poor drainage property of the soil of the

area.

Remedial measures suggested to mitigate the effect of the slope failure are:

- Provide peripheral as well as other surface drainage.
- Divert the Bagmati River from present flow channel to the west by digging a trench.
- Drain out all the dug wells immediately.
- Seal all the tension cracks by impervious clay or other suitable material.
- Provide river training work all along the toe part of the slide.
- Carry out detail investigation of the area to determine the depth of the slip surface, soil properties etc. and design the long term preventive measures accordingly.
- Install suitable monitoring techniques and monitor the slope systematically.
- Modify stabilising techniques according to the findings of the monitoring programme.

Santi Basti is not an isolated case of slope failure hazard in the Kathmandu Valley. There are many slopes similar to Santi Basti, specially along the river banks, occupied by highly plastic silty clay of Lukundol formation. The

engineering and environmental geological map prepared by the Department of Mines and

Geology (DMG) shows most of the area occupied by such soil.

## Rehabilitation Activities in Phedigaon Following the 1993 Disaster

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### ABSTRACT

Incessant rain of July 19 and 20, 1993, caused heavy damages in most part of the Bagmati River basin in central Nepal. Phedigaon, a village situated in the Palung Valley of Kulekhani watershed in the western Bagmati basin was one of the devastated areas. Phedigaon suffered a heavy loss of life and properties. Apart from rescue and relief operations, nothing substantial had been done for about six months. An organized effort on the part of the flood victims made it possible for them to get funding and guidance from individuals at home and abroad to carryout rehabilitation of the village. Ninety most affected households have been able to resettle and build hope for the future. Today, they have been able to live from the food produced on their own once devastated land.

### BACKGROUND

Phedigaon is situated in the western part of the Bagmati watershed at an elevation of 1830 meters above sea level. It lies within the subcatchment area of the Kulekhani watershed in the Palung Valley and is situated near the confluence of the Katre and Khairani Khola which drain into the Kulekhani reservoir. Phedigaon, which is close to Tribhuwan Highway, is comprised of about 248 households with a population of 1850. Before the disaster of July 1993, the farmers of Phedigaon made their living by producing vegetables. Even though they had very small land holdings (of only 0.2 to 0.5 ha), farmers were able to grow enough vegetables such as cauliflower, radishes, potatoes, and beans to raise sufficient cash to provide for their daily needs. Water from the Katre and Khairani Khola was used to irrigate their fields. The people had organized a collection center to which farmers delivered their vegetables and from which a wholesaler took the vegetables to Kathmandu.

The catastrophic rainfall of July 19 and 20, which dumped 500 mm in 24 hours, completely

destroyed this smoothly operating system. Within 12 hours, the life of the villagers was radically changed. The intense rain brought a huge amount of debris and left behind a devastated village.

The damages incurred include the following:

- 38 houses were partly or completely damaged.
- 62 people were killed.
- 274 animals were killed.
- 700 to 800 *ropani* of land was damaged or buried under debris.
- 90 hectares of lowland in the Palung Valley was buried under sand and gravel.
- 90 families were rendered homeless and landless.

Phedigaon was once well-known for its potatoes and winter vegetables. One *ropani* of land produced between Rs. 20,000 and Rs. 30,000 worth of vegetables annually. The loss of productive land in Phedigaon meant an annual loss of vegetables worth Rs. 17.5 million to Rs. 24 million.

Immediately after the disaster, some relief work was carried out by the government. Tents and food were provided to the flood victims. People who lost their loved ones got money to perform the last rituals for the deceased.

Because Phedigaon is so easily accessible from the Tribhuwan Highway, the flood victims in Phedigaon received more visitors from different organizations who wanted to know what had happened, why it had happened and what could be done to help them than did other areas affected by flood in the same year. By the time those visitors arrived, the people of Phedigaon had already started reclaiming of the land and rebuilding shelters. Though, very little was actually accomplished due to the lack of money. In the beginning they made their living through the sale of stones brought by the flood.

Seven months after the disaster when Bagmati Watershed Project (BWP) staff visited the area to study the watershed in February 1994, life in Phedigaon was still hopeless. Men,

women, and children, many scantily clad in rags, surrounded us. They probably thought that we also were visitors coming to ask endless questions. These people were still fearful of the nightmare that they had suffered.

We concluded that people of Phedigaon must be helped without delay and, in particular, before the onset of the 1994 monsoon season. We knew that we had only four months left before the monsoon.

The following steps were followed in the planning and execution of the rehabilitation work.

#### **Step 1: Group formation**

Ninety flood affected families formed a group. They categorized the flood victims into three categories and formulated a rehabilitation program of their own.

#### **Step 2: Fund Raising**

The rehabilitation program of the flood affected area was sent to different individuals requesting for fund to help the flood victims. The following individuals generously made fund available for the rehabilitation works.

1. Young Nepal football players through their German coach 6,000 DM (Rs 448,000)
2. Royal Nepal Consul in Stuttgart (Mrs. A.K. Bauknecht) 28,000 DM (Rs 784,000)
3. Friends in Japan, through Mr. H. Oi, JICA 10,000 US\$ (Rs 490,000)
4. Mrs. A.K. Bauknecht (for school only) 8,000 DM (Rs 277,040)

#### **Step 3: Implementation**

The people of Phedigaon themselves implemented the entire rehabilitation work under the technical supervision and guidance of BWP staff.

### **RESULTS**

Following a total expenditure of about NRs. 18,65,000 and the victims' own labor worth about Rs. 12,00,000, ninety families have resettled in the same place. A little over 360 *ropani* of buried land has been reclaimed by transporting soil from as far away as one kilometer.

Each family now earns between Rs. 5,000 and 15,000 from vegetable production on each *ropani* of land. They have already recovered the cost involved in the rehabilitation work.

Within just three years, the people are again optimistic about their future.

### **CONCLUSION**

Life is dear and precious. The threat of landslides and floods to the life and properties has to be reduced using the available technology and resources. In many cases their remedy may lie within the existent technology. The occurrence of floods and landslides, however, cannot be completely prevented in as weak and fragile hills and mountains as we have in Nepal. It may be practically very difficult to move or resettle people from flood or landslide prone to safer areas, especially when people have lived in such areas for generations. Therefore what needs to be done is to make an organized effort towards rehabilitating areas damaged by floods and landslides. Our experience in Phedigaon is that villagers themselves have the ability and the necessary skills to rehabilitate their villages once financial and technical help is extended.

## **Need for Glacier Lakes and Glacier Lake outburst Flood Studies in Nepal Himalayas**

**P.K. Mool**

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Most of the glaciers are actively retreating in the Nepal Himalayas forming glacier lakes at their terminus part dammed by the end moraines. The most glacier lakes of Nepal, and adjoining Tibet in China are located in the eastern part of the region. Glacier lakes can burst out due to

various reasons (e.g. increase in temperature, high precipitation, earthquake, mass-movements, avalanches, etc.). Flood caused by the sudden bursting of glacier lakes, either ice-dammed or moraine-dammed, are called Glacier Lake Outburst Flood (GLOF). Though not

adequately documented the GLOF phenomenon seems common in this part of the region and occurred in almost every decades in the past. Only in the last decade after Zhangzangbo GLOF on 11 July 1981 and the Dig Tsho GLOF on 4 August 1985 had drawn scientific attention on this aspects. Most of the GLOFs occurred on the major rivers in the Kosi basin (Kosi in Nepal) and Pumqu basin in Tibet, China. The discharge and transport of sediment during GLOF can be exceptionally high. The main impact of GLOF is extensive loss of human lives, destruction of infrastructures and land which cannot be reclaimed for several years, and also interruption of tourism in mountainous area.

Some potentially dangerous glacier lakes and GLOF studies have been carried out in Nepal. Investigation of the Dig Tsho glacier lake, Imja glacier lake, Lower Barun glacier lake, Tsho Rolpa glacier lake, Thulagi glacier lake were carried out. Detailed and long-term investigation of the high-potentially dangerous Tsho Rolpa glacier lake in the Rolwaling Valley was started in 1993 by Nepalese, Japanese, Dutch, British researchers and should be considered as model lake for study and mitigation work. The Tsho Rolpa glacier lake has developed from 0.23 sq. Km. (1959) to 1.37 sq. Km. (1993) The Tsho Rolpa Glacier lake might have been started to form around 1950. The present maximum depth of the lake is 132 m with 71 million cubic meter

of water. Lots of scientific information are gathered about the lake and the downstream area. Through the charity activity, a test siphon to test the mechanism and the material were installed in the Tsho Rolpa. The real mitigation work is still to be carried out. There are potential dangerous glacier lakes in other areas like in Mustang where there are clear geomorphic evidence of GLOF in the recent past.

Several potential dangerous glacier lakes have been identified in field in the Tibetan part of China which could also effect inside Nepal. There was GLOF from Phuchan lake in Tamur basin dammed the river forming a lake. The breached moraines continue to collapse easily and dam the glacier melt water into the lake as in the past form. Such lakes are more vulnerable to breach out in near future. Most of the glacier lakes which burst in past (Zhangzangbo, Dig Tsho, Puchan, and even Gelhaipuco) are gaining their water levels which could burst out in near future. Inventories of the glacier lakes of Nepal and the adjoining common basin in China should be done and potential dangerous lake should be studied in detail with coordinated multidisciplinary approach and the mitigation measures must be well taken care in time to save the lives and properties. Early warning system will be less effective in case of the GLOF from moraine dammed glacier lakes.

### Constraining a Great Earthquake in Western Nepal in Space and Time

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Big earthquakes in the Himalayan arc are caused due to stick sliding of the Indian plate along subhorizontal detachment plane in the process of continental convergence between Tibet and India. The space - time distribution of such big earthquakes, therefore, can be understood from seismic gap approach in analogy with earthquake distribution in oceanic subduction zone (Seeber and Armbruster, 1981). The seismic gap extending from Dehradun, India to Gorkha(?), Nepal which has not ruptured for the last 587 years, or more, has been supposed to be the site for the next big earthquake within the Himalayan arc of Nepal from the analysis of historical seismicity (Bilham, 1995).

A seismotectonic model of Central Nepal Himalaya has been derived from microseismic

observation and results of geological and geophysical studies. It is consistent with the ramp of the Indian plate at depth acting as the geometrical asperity for the accumulation of stress and strain in the interseismic period. The ramp at the depth correlates in the surface with the topographical front of the Higher Himalaya. The frontal, shallow dipping detachment is quiescent and accumulates strain (Pandey et al., 1995). Big earthquakes of magnitude about 8 like those of 1833 and 1934 events nucleate near the ramp-flat transition and ruptures the detachment up to the frontal fault in the south. This model, in general, can be applied to the predicted gap with subsequent modification of ramp-flat geometry. However, the gap seems to



comprise of several segments of rupture along the arc. The length of rupture along the arc constrains the magnitude and also defines the number of big events to rupture the entire gap.

So far there is no sufficient precise information on historical seismicity to define the limits of such segments. The results of microseismic monitoring by National Seismological Centre, Department of Mines and Geology for the period 1994 March - 1995 December, exhibit high activity along the topographic front of high Himalaya. However the rate of microseismicity is not uniform along the arc and probably reflects the bounds of each potential rupture segment. The high microseismicity rate from 80E to 82.5E longitude seems to correspond to a potential segment like that of 1905 Kangra earthquake of 8.0 magnitude. Similar geological and

geomorphological features have been reported by Yeats and Lillie, 1991.

About 1.3 million human lives, 400,000 houses and 4 concrete bridges are exposed to earthquake risk corresponding to projected IX and VIII MM intensity, if an event should occur near 80E longitude with a rupture length of about 225 km. Risk at lower intensity area due to secondary hazards like liquefaction are not taken into account.

The activity of moderate and small earthquakes in western Nepal Himalaya within the domain of probable rupture area in the last 40 years seems to correspond to preseismic activity of an incoming major event. Cumulative seismic moment release in the last 40 years have reached values comparable to San Francisco bay area prior to main event (Sykes and Jaume, 1990).

### **River Pollution in Kathmandu Valley and its Environmental Impacts**

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Rivers of the Kathmandu Valley are dying mainly because of excessive water extraction at the head waters and water pollution by the discharge of municipal and industrial effluents and solid wastes.

Misuse of the river water resource in the valley is linked with the rapid urban expansion with inadequate infrastructure development. Though these activities are said to have been for the comfort of the common mass, has had direct and indirect impacts on the river hydrology and

ecology in one hand while on the other hand has inflicted irreversible damage to the health and hygiene of the Kathmandu urbanites and rural inhabitants through various environmental chain systems.

This paper evaluates the river water pollution in the Kathmandu Valley emphasizing the cause and effects in order to identify a pragmatic solution to negate the observed environmental effects.

### **Natural Disaster of 2053 BS**

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Nepal is hit by various types of natural disasters every year. Most of the disasters take place between Baishakh and Bhadra (April and September). The average casualties exceeds one hundred per year.

In the year 2053 BS, Nepal was hit by natural disasters like storm in the eastern plains, landslides and debris flows in the middle mountains, flood in the mountains as well as the plains.

In this paper, efforts are being made to relate various types of natural disasters taking place between April and September 1996 with casualties. Similarly, the districtwise distribution as well as regional distribution of natural disasters are being discussed.

Based on the conclusions, some rational steps (recommendations) are suggested to minimize the risk of natural hazards.

## Use of Bio-Engineering in the Road Sector of Nepal

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### ABSTRACT

With extremely adverse terrain for the development of linear infrastructure in the mountains of Nepal, careful approaches to slope stabilisation are required. In the road sector, low traffic levels on mountain roads mean that low cost techniques are required but that an element of risk is acceptable. Within this setting, a number of cost-effective approaches are feasible. This paper examines the use of bio-engineering techniques in the Nepal road sector. A wide range of appropriate techniques have been used. There are numerous suitable species for this available locally. The general principles and their practical application are discussed.

The general environment of the Nepal Himalaya is extremely hostile to the development of any form of infrastructure. Mountain building is a continuing process in the Himalaya, with down-cutting rivers and steepening slopes being very common as a result. The geology is highly mixed and disturbed as a result of these orogenic processes; there are several major active faults running the length of Nepal, as well as numerous more localised lines. Roads, forming a linear network through the mountains, invariably cross slopes with intractable problems of instability. In the road sector this is now acknowledged as an inevitable problem and some disruption during the monsoon rains is becoming accepted on many highways.

In addition to the problems which arise from the geological situation, the climate provides further difficulties. For the four months of summer, the south-west monsoon wind brings warm, humid air off the Indian Ocean. This gives rise to rapid weathering rates at lower altitudes and a period of saturation during which most of the slope movements and erosion occur. Annual rainfall can be at least 5,000 mm in places (90% falling in four months) and rainfall intensities can exceed 100 mm per hour and may even surpass 200 mm per hour.

A low cost approach to damage and disaster prevention is therefore called for which involves

prudent risk management. In deciding the type and extent of the treatment to be adopted for slope stabilisation in vulnerable areas, an attempt should be made to balance the costs of risk reduction against road user delay costs and the social costs of road closure, as well as the costs of road repairs and subsequent maintenance.

The low cost strategies used by the Department of Roads are not therefore intended to avoid disaster altogether. In such an environment, it is rarely practically or economically possible to do so. The objective is to reach an affordable level of risk management from both the financial and social cost aspects.

Bio-engineering techniques can play a major part in providing low cost prevention and reduction of erosion. However, they represent only one part of the equation. It is important that they are combined in a total package if they are to be fully successful. The full range of low cost approaches which are practicably attainable amount to the following six approaches:

- \* Reduction and careful disposal of spoil;
- \* Attention to slope drainage;
- \* Care in choosing and applying slope stabilisation measures;
- \* Attention to road drainage systems;
- \* Bio-engineering and vegetation structures;
- \* Collaboration with road neighbours;
- \* Simple maintenance management.

**Plants available for bio-engineering.** There are hundreds of potential bio-engineering plants in Nepal. The main features which are required are as follows.

- \* Good rooting system.
- \* Perennial growth.
- \* Ability to survive on stony sites.
- \* Ability to survive on hot, dry sites.
- \* Resistance to grazing.
- \* Ability to recover from damage.

Species which should not be used include those which are annual, not perennial, and which have a poor, weak root system or a shallow root system. Such plants never give the desired effects.



# जोखिमपूर्ण अवस्थामा रहेका नेपाली शहरहरूमा प्राकृतिक प्रकोपको न्यूनिकरण

महेश नकर्मि

आवास तथा भौतिक योजना मन्त्रालय

विश्वमा बढ्दो शहरीकरणले गर्दा विभिन्न समयमा घटेका प्राकृतिक प्रकोपका घटनाहरूले शहरी क्षेत्रमा गम्भीर रूपमा असर पारी वढी घनजनको क्षति पु-याइरहेको हामीलाई विदितै छ । यसमध्ये विश्वको आधाभन्दा बढी जनसंख्या भएको एशिया प्रशान्त क्षेत्रमा विश्वमा घटेका प्राकृतिक प्रकोप मध्ये करिब ८५ प्रतिशत घटना यस क्षेत्रमा घटेका पाइन्छ । जस्तै गर्दा एशिया प्रशान्त क्षेत्रका धेरै शहरहरू प्राकृतिक प्रकोपबाट प्रभावित भएका छन् । यसैगरी नेपालका विभिन्न शहरहरूमा पनि विभिन्न समयमा घटेका प्राकृतिक प्रकोप जस्तै भूकम्प, बाढी, पहिरो, आगलागी इत्यादि घटनाहरूले असर पारेका छन् । यी मध्ये यस लेखमा विशेषतः भूकम्प सम्बन्धि बिबेचना गरिएको छ ।

नेपाल एक भूकम्पजन्य खतरा भएको देश हो । यस समस्याको न्यूनिकरणको लागि देशका सम्पूर्ण भूगर्भविद् तथा भूकम्पविदहरू गहन अध्ययनमा लागेका छन् । श्री ५ को सरकारले पनि यस खतरालाई ध्यानमा राखी संयुक्त राष्ट्र संघको सहयोगमा राष्ट्रीय भवन निर्माण संहिता तर्जुमा (National building code development) गरिसकेको छ । यसमा भूकम्पजन्य खतराको सबैक्षण तथा जोखिमको स्तर निर्धारणको साथ साथै भूकम्प प्रतिरोधात्मक भवन निर्माण संहिता समेत तयारी पारी कार्यान्वयनको लागि प्रकृया अघि बढिसकेको छ ।

तसर्थ भवन निर्माण संहिता पूर्णरूपमा कार्यान्वयन भएपछि भविष्यमा निर्माण हुने भवनहरूलाई भूकम्प

प्रतिरोधात्मक बनाउन सकिन्छ । तर अब प्रश्न उठ्छ यस अघि निर्माण भएका घरहरूको स्थिति कस्तो छ ? अवश्यपनि यस्मा हामिले बिचार पु-याउनु अत्यन्त जरुरी छ । यसका लागि प्राविधिकहरूले पुनः सुदृढिकरण (Retrofitting) को उपाय बारे सुझाव-दिएका छन् तर के यी सबै किसिमका भवनहरूलाई पुनः सुदृढिकरण गर्न व्यवहारिक हुन्छ त ? अवश्य हुँदैन । यसको लागि दीर्घकालीन योजना तयार गरी सोही अनुरूप सुदृढिकरण गर्दै लैजानु उत्तम हुनेछ । यसरी नै भूकम्प जस्तो प्राकृतिक प्रकोपबाट शहरहरू प्रभावित हुन सक्ने असरलाई न्यूनिकरण गर्नको लागि हामीले यथासम्भव छिटो शहरी भूकम्पीय प्रकोप कृष्यपटल (Urban Earthquake Disaster Scenario) तर्जुमा गरी सोको कार्यान्वयन गर्नपनि अति आवश्यक छ । यसबाट हामीले भूकम्पबाट हुन सक्ने क्षतिको पूर्व अनुमान गर्न सक्छौ र जस्तै गर्दा भूकम्पबाट सुरक्षित रहनको लागि पूर्व तयारी गर्न सहयोग मिल्दछ ।

हाम्रो दायित्वपनि यस मूलकमा हुनसक्ने प्राकृतिक प्रकोपको असर न्यूनिकरण गर्नु हो । जस्तै गर्दा घन जनको कम नोक्सानी हुनुका साथै उद्धार, राहत, पुनरस्थापन, पूर्व निर्माण र व्यवस्थापन गर्न धेरै सजिलो हुन सकोस् । प्राकृतिक प्रकोप न्यूनिकरण दशकको मूलभूत उद्देश्य पनि यही हो । प्रस्तुत लेखमा नेपालका शहरवास्तिका लागि आवश्यक भूकम्प पूर्व तयारीको सिद्धान्तहरूको विषयमा लेखाजोखा गरिएको छ ।

□

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### तालीम तथा कार्यशाला गोष्ठी

२७ नोभेम्बर १९९६ - काठमाडौं, नेपाल

नेपालमा IDNDR-Day मनाउने सिलसिलामा नेपाल भौगर्भिक समाजले सर्वप्रथम काठमाडौं स्थित केहि माध्यमिक स्कूलका शिक्षकहरूलाई "प्राकृतिक प्रकोप र त्यसको लागि तयारी" विषयमा २७ नोभेम्बर १९९६ का दिन काठमाडौंमा एकदिने कार्यशाला गोष्ठी तथा तालीमको आयोजना गरेको थियो। उक्त गोष्ठी तथा तालीम मुख्यतः Lutheran World Service/Nepal को सहयोगमा सञ्चालन भएको थियो। उक्त तालीमको उद्घाटन प्रमुख अतिथि माननीय शिक्षामन्त्री गोविन्दराज जोशीबाट सम्पन्न भएको थियो भने उक्त उद्घाटन समारोहको सभापतित्व काठमाडौं महानगरपालिकाका प्रमुख श्री पी.एल. सिंहले गर्नुभएको थियो।

उद्घाटन समारोहमा नेपाल भौगर्भिक समाजका अध्यक्ष डा. विशालनाथ उप्रेतीबाट अतिथि तथा सहभागीहरू को स्वागत भएको थियो भने Lutheran World Service/Nepal का Project Director, Todd Stowell ले कार्यक्रमबारे प्रकाश पार्नुभएको थियो। प्रमुख अतिथि शिक्षा मन्त्री श्री गोविन्दराज जोशीज्यूले यस्तो गोष्ठीबाट सहभागीहरूलाई प्राकृतिक प्रकोपको रोकथाम तथा यसबाट बच्ने पूर्वतयारीबारे ज्ञान उपलब्ध हुने र सो ज्ञान विद्यार्थीहरूको माध्यमबाट घर-परिवारसम्म पुग्न सक्ने भएको हुँदा यस्तो गोष्ठीको ठूलो महत्त्व भएको विचार व्यक्त गर्नुभयो। त्यसैगरी काठमाडौं महानगरपालिकाका प्रमुख श्री पी.एल.

सिंहज्यूले प्राकृतिक प्रकोपको रोकथाममा विद्यालयका शिक्षकहरूबाट हुनसक्ने योगदानबारे प्रकाश पार्नुभएको थियो।

उक्त गोष्ठी तथा तालीममा काठमाडौं उपत्यकाका माध्यमिक विद्यालयका ३० जना शिक्षक तथा शिक्षिकाहरूको सहभागिता रहेको थियो। त्यस्तै शिक्षा मन्त्रालयबाट ८ जना र निजी स्कूलहरूबाट ६ जना तथा विभिन्न सरकारी एवं गैर-सरकारी संस्था तथा वैदेशिक नियोगहरूबाट १६ जना गरी जम्मा ६० जना उक्त गोष्ठी तथा तालीममा सहभागी भएका थिए।

तालीमका सहभागीहरूकातर्फबाट सो गोष्ठी निकै उपयोगी भएको र यसबाट प्राप्त ज्ञान विद्यालयका बालबालिकाहरूलाई बोध गराई उनिहरूकोतर्फबाट घर-परिवारलाई पनि प्राकृतिक प्रकोपबाट हुने घनजनको क्षति न्यून गर्ने उपायहरू सिक्नु सकिनेछु भन्ने विचार प्रकट गर्दै यस किसिमको तालीम स्थानीय तहमा पनि कार्यक्रम सञ्चालन गरिएमा धेरैभन्दा धेरै जनसमुदायमा प्राकृतिक प्रकोपबाट बच्ने उपायहरूको ज्ञान बढ्ने थियो भन्ने कुरा व्यक्त गरियो।

उक्त समारोहमा UNDP Disaster Management Secretariat का Coordinator, Mr. William Berger, शिक्षा सचिव, उपत्यकाका जिल्ला शिक्षा अधिकारीहरूको पनि उपस्थिति थियो।

### प्राकृतिक प्रकोप कम गर्न जनसचेतता आवश्यक

प्राकृतिक प्रकोप न्यूनीकरण सम्बन्धी अन्तर्राष्ट्रिय दशकका सन्दर्भमा नेपालमा भौगर्भिक समाजद्वारा हालै यहाँ सो सम्बन्धी कार्यशाला तालीम आयोजना गरियो।

उक्त कार्यक्रममा नेपालमा भूकम्पको जोखिम र हेका क्षेत्रहरूको अध्ययन, हिमाली भेगमा बाढी र पहिरो, जोखिम क्षेत्रको नक्शा, ऐतिहासिक भूकम्प, कम खर्चिलो पहिरो नियन्त्रण कार्य आदि विषयमा विस्तृत छलफल भएको थियो।

कार्यशाला तालीमको उद्घाटन गर्दै शिक्षामन्त्री गोविन्दराज जोशीले नेपाल भूकम्पको जोखिम क्षेत्रमा रहेको तर अधिकांश नेपाली जनता प्राकृतिक प्रकोप न्यूनीकरणको सम्भावनाप्रति सजग नरहेको अवस्थामा यस प्रकारका

कार्यशाला र तालीमबाट अत्यन्त महत्त्वपूर्ण सहयोग पुग्ने कुरा बताउनुभयो।

काठमाडौं महानगरपालिका प्रमुख पी.एल.सिंहले हरेक प्राकृतिक प्रकोपबाट सर्वप्रथम स्थानीय बासिन्दा नै पीडित हुने भएकाले उनीहरूलाई नै यसप्रति सजग र सचेत गराउनु आवश्यक भएको विचार व्यक्त गर्नुभयो।

लुथरन वर्ल्ड सर्भिस, नेपाल डिजास्टर प्रिपरेनेस प्रोजेक्टका संयोजक टड स्टोवेलले क्यालिफोर्नियाको भूकम्पको उदाहरण दिँदै नेपालमा पनि त्यस किसिमको भूकम्पबाट हुन सक्ने क्षतिलाई न्यून गर्नसकिने कुरामा जोड दिनुभयो।

कान्तिपुर, मंसिर २०, २०५३

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# An overview of the mineral resources of Nepal

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## INTRODUCTION

The kingdom of Nepal lies in the central sector of the 2,400 km long Himalayan arc. From south to north, it is geologically divided into four major zones viz., the Terai (the northern edge of the Gangetic plain), the Siwaliks (Churia), the Lesser Himalaya, the Higher Himalaya and the Tibetan-Tethys Zone (Fig. 1). Only a very limited area of Nepal lies in the Tibetan Tethys Zone. The boundaries between these zones are marked by distinct and east-west trending thrusts and faults. Each of these zones has its own physiographic, climatic and geologic characteristics with different mineral potentials.

The Himalaya is the youngest and the highest mountain of our planet. The mountain owes its origin to the collision of the northward moving Indian plate with the Eurasian plate that occurred around 50 million years before. The continued northward denting of the Indian plate against its northern counterpart has maintained the rise of the mountain even today. The active nature of the mountain is manifested by the occurrence of a large number of earthquakes which sometimes bring big disasters in the region. Today, the modern technology (Global Positioning System or GPS measurement using information from orbiting satellites) allows us to accurately measure the northward rate of movement of India and the rate of vertical rise of the Himalaya within the accuracy range of around a couple of millimeters per year. The measurements have shown that India is approaching Tibet at the rate of 15 to 20 mm per year and the maximum rate of uplift in some parts of the Himalaya is recorded to be as much as 7 mm per year (e.g. around the Chaku Village along the Arniko Highway).

## HISTORY OF MINERAL EXPLORATION IN NEPAL

As late as 1950, Nepal was producing, in small amount, many kinds of minerals and metals using age old traditional techniques.

However, after Nepal opened its borders to the outside world in 1951, the increased pace of development activities of the country required a much larger amount and reliable supply of all kinds of these commodities. Shortly after, therefore, the cheap imports replaced the domestic supply and caused a sudden demise of small scale mineral based industries of Nepal.

On government level, the establishment of Khani Adda in 1941 was the first step towards the mineral resources development in Nepal in an organised way. However, the establishment of the Nepal Bureau of Mines in 1964 may be considered as the beginning of the modern era of geologic studies and the mineral exploration in Nepal. Therefore, the present-day knowledge on the geology and mineral resources of Nepal is the result of the studies basically carried out only within the last three to four decades. It is not a very long period for mineral exploration activities of any country. Presently, the Department of Mines and Geology/HMG has the main responsibility for the mineral resources development in the country.

Geological mapping is the first step towards assessing the mineral potential of any country. The first comprehensive reconnaissance geological survey of Nepal was carried out by Toni Hagen between the period of 1951 and 1959. A more systematic and regular mapping programme could start only after 1967 when the Department of Geological Survey was created. Later in 1976, this department was merged with the Bureau of Mines, and finally the Department of Mines and Geology (DMG) came into existence. By now most part of the country has been geologically mapped in one inch to a mile scale. The DMG has published a series of geological maps of the country in a 1:250,000 and in 1:1000,000 scale. This first stage of mapping has enabled us to build some fair idea of the mineral resources potential of Nepal. However, it may be emphasised here that geological mapping is a continuous process. Most areas need re-mapping on a larger scale and continuous updating of the geological information for the mineral resources development.

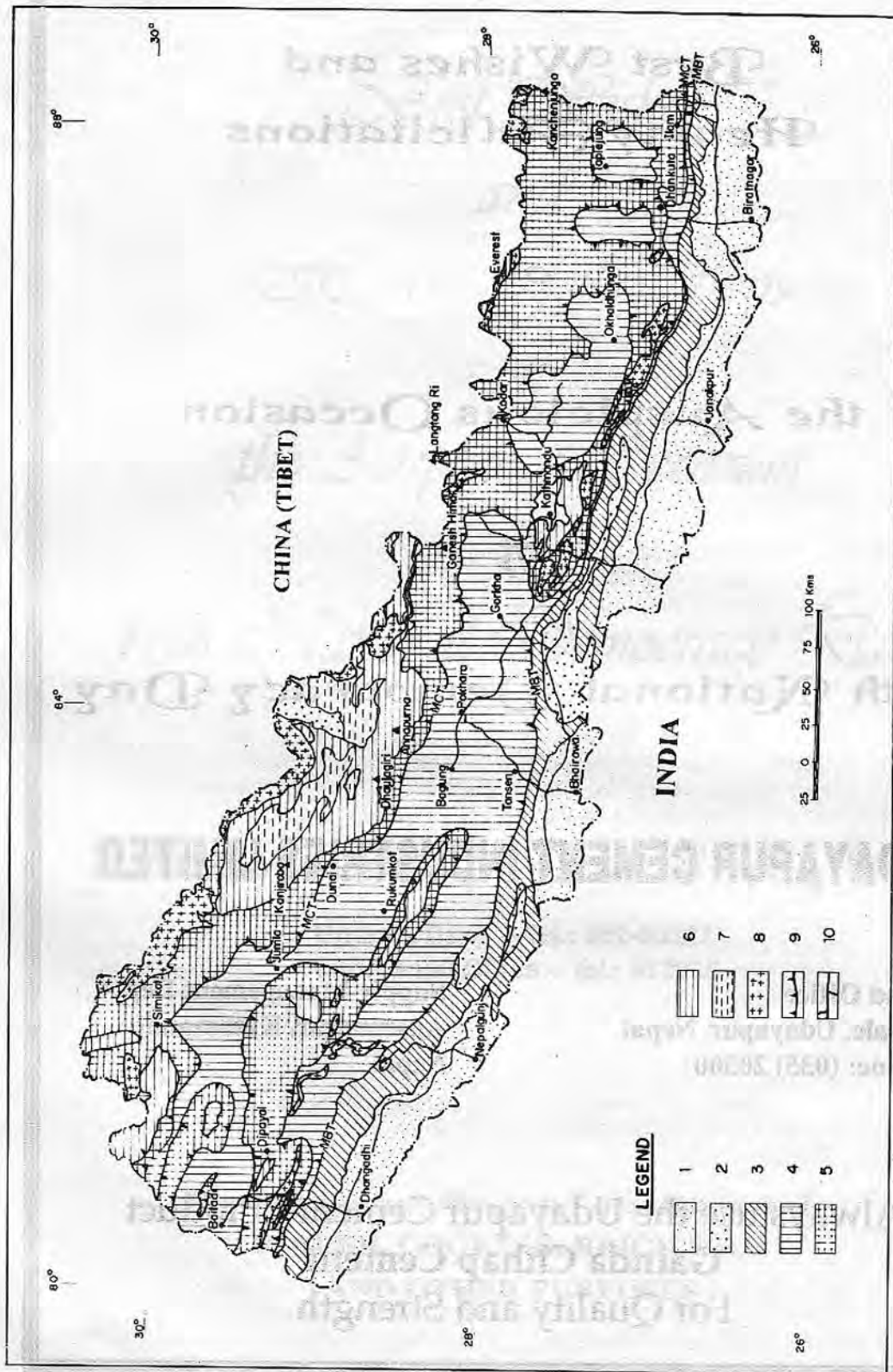


Fig. 1. Geological Map of Nepal (Upreti & Dhital, 1996). Legend: 1. Terai Zone 2. Dun Valleys 3. Churia Zone (Siwalik Zone) 4. Lesser Himalayan Zone 5. Higher Himalayan Zone 6. Tibetan Tethys Zone (Rocks of Paleozoic age) 7. Tibetan Tethys Zone (Rocks of Mesozoic age) 8. Thrusts 9. Roads.



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## MINERAL POTENTIAL OF NEPAL

Geological study shows that the Terai may be considered important for oil, natural gas and groundwater resources, the Siwaliks (Churia) is a zone which has potential for radioactive minerals, the Lesser Himalaya is important for metallic (copper, lead, zinc, gold, etc.) and non-metallic deposits (limestones, magnesite, phosphorite, coal, etc.) and the Higher Himalaya has shown prospects for metallic and radioactive minerals. (Fig. 2)

It is generally said that Himalaya is a very young mountain and therefore it has not much prospect for mineral resources. The above popular notion perhaps needs some clarification. In Nepal, when we think about mineral resources, we generally think only about the metallic mineral deposits such as gold, silver, copper, lead, zinc, iron, etc. The non-metallic minerals are also equally important and essential for the development of any country. There are also other categories of useful geologic materials such as fuel minerals viz., coal, petroleum and natural gas, precious and semi-precious stones, construction materials and dimension stones. Therefore, when one refers mineral potential of Nepal, not only the metallic deposits but all these kinds of resources are to be considered.

A brief description of the mineral occurrences in Nepal is presented below. However, it may be remembered that there are a vast number of reported occurrences of various minerals which need further geologic investigations to assess their actual potential. Only the important deposits/occurrences which have been geologically investigated are discussed here.

### Metallic Minerals

#### *Copper*

Nepal was known for its copper production since historic times. Though in a very small scale, copper is the only metal which is continued to be produced in Nepal even today (DMG, 1996). There are a large number of occurrences and old workings of copper ores in Nepal. At least 75 such important occurrences are reported and listed. All of these occurrences are reported from the Lesser Himalayan Zone. DMG carried out investigation of over 27 such known old workings (ESCAP/DMG, 1993). The studies,

however, have shown that all the deposits are too small for large scale mining. The Wapsa Deposit of Solu Khumbu district (1.74 million tons of ore with 0.88% copper), the Gyzi prospect of Gorkha district and Baisekhani (Okharbot) prospect lying in the Baglung, Myagdi and Gulmi districts are the only deposits still being mined following the traditional methods of mining and smelting.

The last three decades were primarily spent for the basic geological mapping in Nepal. The preliminary or first phase of geological investigation has been more or less accomplished (except the Higher Himalaya). The investigation has helped to scrutinise the known occurrences and old workings and has been able to identify new occurrences of copper deposits in Nepal. Some of them have been investigated in detail and many more are to be further studied. During this period very little attention could be paid for detailed investigation of each known occurrences of copper ores. In fact, most of the mineral exploration work in the central Nepal was carried out by the Mineral Exploration Project of Department of Mines and Geology (1975-79) under the technical and financial support of UNDP. Therefore, the present knowledge about the copper deposits in Nepal are based only on the limited amount of investigation. Though the presently studied copper ore deposits in Nepal do not present an encouraging scenario, it is definitely not disappointing either. Further work in the future may bring more realistic picture about the potential of copper deposits in Nepal.

#### *Lead and Zinc*

The only metallic mineral deposit in Nepal which can be considered as economic deposit is the Ganesh Himal lead and zinc deposit of Central Nepal lying about 58 km NNW of Kathmandu. A recent UNDP study has estimated 811,830 tons of ore averaging 16.44% zinc, 2.55% lead and 32.4 ppm silver. It is believed that there are 2-3 million tons of ore at the minimum in the adjacent areas which need further exploration (Ghimire et al., 1996). The mining area is located in a remote and high altitude area. The falling price of the metals in the international market, has necessitated further investigation to increase the total proved reserve in the area.

There are many other reported occurrences of lead and zinc ores from widely scattered areas in Nepal. There are at least 10 such important



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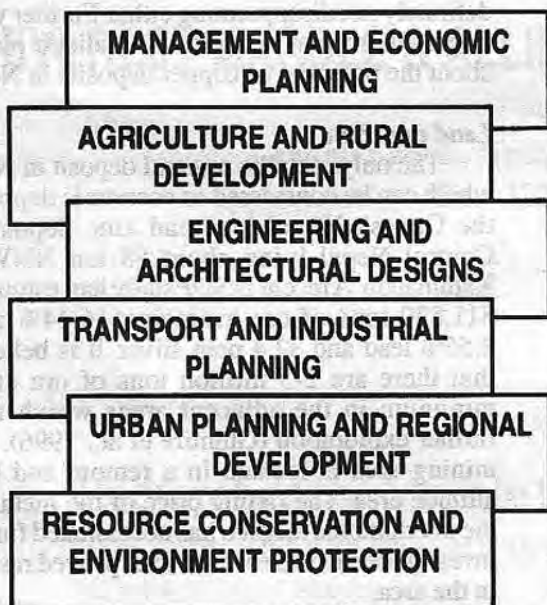
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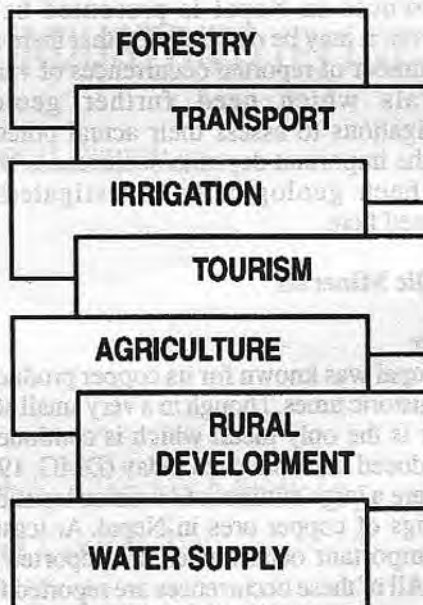
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### Field of Activities



### Field of Activities



reported occurrences (ESCAP/DMG, 1993). Some of them have been studied in detail and others are to be investigated further. The Khairang lead-zinc deposit in Makwanpur district has 1.54 million tons with 2% combined lead-zinc (ESCAP/DMG, 1993). It may be quite likely that in future further investigation along the similar geologic formations as that of the Ganesh Himal deposit may help to find more number of large lead-zinc deposits in Nepal.

### **Iron**

For centuries Nepal used to produce iron to meet its domestic requirement and even exported to Tibet. Old workings for iron ores are scattered all over the country. However, after 1950, the supplies were insufficient and cheap imports replaced the indigenous production. Presently no iron ore mines are in operation in Nepal. The noted iron ore deposits of Nepal are the Phulchauki iron ore deposit in the Kathmandu Valley, the Thoshe iron prospect in Ramechhap district, the Jelbang iron prospect in the Rolpa district, and the Labdi Khola-Bhut Khola iron prospect in the Tanahu district.

The Phulchauki iron ore deposit is one of the most extensively studied iron ore deposits in Nepal. Detailed exploration indicated a potential iron ore of 10.67 million tons (ESCAP/DMG, 1993). The Thoshe iron prospect lies about 15 km south east of Jiri. The preliminary assessment of the deposit revealed possible deposit of about 10 million tons of iron ore of about 40% iron (Kaphle, 1996). The Labdi Khola deposit has about 1.08 million tons with 38% iron.

Today, an economically viable iron ore deposit needs to be of much bigger size and of higher grade than the ones so far found in Nepal. Based on the present knowledge of the occurrences of the deposits, it may be said that there is very little prospect for iron ore production in Nepal on a large scale.

### **Gold**

Gold occurrences along some of the major rivers of Nepal are known since centuries, and gold panning in some of these rivers is still continued. The gold found in the sand and gravel deposits of the rivers are called placer gold. They are derived from the primary source in the rock and during transportation by the rivers along with the sediments get concentrated in some favourable locations. Placer gold occurrences in

Nepal have been studied in the Lungri Khola of Rolpa district, Sunmai and Bering Khola of Ilam district and Chamliya -Mahakali river area of Baitadi and Darchula districts, Kali Gandaki river, Burhi Gandaki-Trishuli area, Modi Khola and Reu Khola (Rapti Valley) of western and central Nepal. There are also other major rivers like Koshi, Karnali, Bheri, Seti, Marshyangdi etc. where gold occurrences have been reported. In more recent years, Lungri Khola, Sunmai and Bering Khola, Mahakali and Chamliya rivers have been taken up for more detail studies. In some of these areas, the source rocks are also being investigated and encouraging results have been found (Kaphle et al., 1996).

Considering the stable price of gold in international market and geographic condition of Nepal, it is advisable that DMG should give more emphasis to gold exploration (both placer and primary gold) using modern techniques.

### **Uranium**

Uranium is a very high value radioactive mineral. The rocks of Churia (Siwaliks) are prospective for this mineral. Some works have been done in the Churia rocks and uranium mineralisation were reported from the Buka Khola, Chiruwa Khola, Chandi Khola, Tinbhangle Khola, Mardar Khola and Panpa Khola area of central Nepal (ESCAP/DMG, 1993) and the Jamari gad and the Chamliya river area in Baitadi district, Far western Nepal (Kaphle and Khan, 1993). Out of these areas, the Tinbhangle Khola showed a very promising result. However, so far none of these areas shows economically exploitable grade of uranium ores. The granites and gneissic rocks, especially of the Higher Himalaya, may also be considered as a good source rock for uranium minerals and need further studies.

### **Non-metallic Minerals**

#### **Magnesite**

Magnesite is a refractory mineral that can withstand very high temperature, and has a wide range of uses in industries. Though there are a large number of reported occurrences of magnesite, only two of them have been proved economical, viz. The Kharidhunga and Kampughat magnesite deposits.

The Kharidhunga Magnesite deposit is located at Kharidhunga in the Dolkha district (about 112 km east of Kathmandu). A total

reserve of 180 million tons of magnesite with 66 million tons of refractory grade has been estimated. This is considered to be a fairly large deposit of good grade magnesite (ESCAP/DMG, 1993). Magnesite and talc (an associated mineral with the magnesite deposit), are currently being mined.

The Kampughat (Udaipur district of eastern Nepal) deposit contains a probable reserve of 20 million tons of medium to low grade magnesite and presently remains unexploited.

### ***Limestone***

Limestone is a rock which can be used for various purposes depending upon its physical properties or quality and chemical composition. The most pure variety may be used for producing various chemicals (chemical grade limestone). Others are used for producing Portland cement, and still others are used in flooring and facing after cutting and polishing.

### ***Cement-grade Limestone***

Among the mineral based industries, cement industries have become the most important industries in Nepal. In recent years, the production of cement by these industries have substantially reduced the cement import in Nepal, thereby saving a very large amount of foreign currency. They have also become the important revenue source for the government. When more cement industries will come up in the future, the total revenue contribution to the government by the mineral based industries will substantially increase.

The cement-grade limestone deposits which are already being mined for the cement production in Nepal are the Sindali deposit (10 million tons) in the Udaipur district (Udaipur Cement Industry Ltd), the Bhainsedobhan (10.8 million tons) and Okare deposits (8.6 million tons) in the Makwanpur district (Hetauda Cement Industry Ltd.), the Chobhar deposit (13.46 million tons) in the Kathmandu Valley (Himal Cement Company Ltd), and the Beldanda deposit (2.1 million tons) in the Dhading district (Annapurna Cement Pvt. Ltd.) (ESCAP/DMG, 1993). The chemical grade limestone of the Jogimara deposit (0.95 million tons) in Dhading district is being used by the agriculture-lime industries Ltd. for the production of agriculture-lime. Other important limestone deposits which have been investigated in detail are the Nigale deposit (10 million tons) in Dhankutta district,

the Katari-Galtar deposit (18.74 million tons) in Udaipur district, the Panauti deposit (5.84 million tons) and the Salandu (Rosi) deposit (4.31 million tons) in Kabre district, the Argha-Khanchi deposit (8.6 million tons) in Argha-Khanchi district, the Gandari deposit (10 million tons) in Dang district and the Surkhet deposit (30 million tons) in Surkhet district (ESCAP/DMG, 1993).

### ***Marble***

Marble is a rock which is extensively used as a flooring and cladding stone. This rock is also widely occurring in Nepal. However, only the Godavari marble deposit of Kathmandu Valley is being quarried for commercial use and is also exported. It has a probable reserve of 625,000 cubic meters of white pink and brown marble (ESCAP/DMG, 1993).

### ***Precious and Semi-precious stones***

Nepal is gradually becoming an important producer of precious and semi-precious stones. Gemstones like tourmaline, aquamarine and garnet from Nepal have already acquired a good market. Hyakule and Phakuwa areas of Sankhuwa Sabha district in Eastern Nepal are well known for the production of these minerals. Recently, Naje area of Manang district has been found to be a good prospect for gem quality tourmaline and aquamarine (Einfalt et al., 1995). Also, ruby and sapphire have been found in the Ganesh Himal area and more investigation is required to prove its economic prospect.

Further investigation on the occurrences of gem minerals may place Nepal to an important gem exporting country in the region. Mining for gem stones requires relatively small capital investment, accessibility by road is not a prerequisite like in other mining activities, and is normally managed by small scale mining activity. Therefore, there is a very good prospect of development of this sector of mining activity in Nepal and can contribute substantially in the economic development of the country.

### ***Oil and Natural Gas***

Systematic petroleum exploration in Nepal was started only about 20 years before with the first aeromagnetic survey of certain parts of the country. Based on the positive indications shown by this study, the Petroleum Exploration Project was started in 1981 to promote the exploration activities in the country. Petroleum exploration

requires huge investment which is rarely available to a least developed country like Nepal. A very good geological and other related surface and subsurface investigations are needed requiring specialised and experienced manpower. The investment has high risk due to uncertainty in finding the reserve. Therefore, oil and natural gas exploration in Nepal has obviously many inherent problems. Nepal on its own has very limited expertise and capability for petroleum exploration, both in manpower and investment aspects.

A substantial background geological and geophysical work has been already carried out by the Petroleum Exploration Project, Department of Mines and Geology to sufficiently indicate that there is a possibility of the occurrence of petroleum in the southern parts of Nepal including the Siwaliks (Churia) zone and the Terai. The area is divided into 10 smaller blocks of approximately 5,000 square kilometers for further exploration. As the detailed exploration of each of these blocks needs huge investment, expensive equipment, expertise and specialised manpower, Nepal government can not do the exploration work alone. Therefore, the government has opened these blocks for international oil companies for further explorations. In 1986, Shell Nepal & Triton Inc. conducted exploration in block 10 in eastern Nepal (Biratnagar-Jhapa area) and carried out detailed geological and geophysical surveys. The company also drilled a well to a depth of about 3,500 m. The exploration well did not strike oil. At present the government is further updating the background data to attract more investor companies to other blocks.

The geological and geophysical investigations have clearly indicated that there exists a favourable geological conditions (the source rocks as well as structures) for the occurrence of oil in the southern parts of Nepal. The low oil price in the international market, and lack of any pre-existing or proved oil field in the vicinity of Nepal border, has made international companies somewhat reluctant to invest in Nepal. If conditions improve for such investment, Nepal is still a promising ground for oil exploration. Therefore, as a geologist, I would definitely place Nepal on a map of prospective oil fields. Drilling of one exploratory hole within the

whole prospective zone does not prove or disprove anything. Continued efforts for more investment on exploration is the only option left at present.

#### *Natural gas in Kathmandu Valley*

Occurrence of natural gas in the Kathmandu Valley was known for many years. However, only recently the exploration work has been completed and 47.6 million cubic meters of natural gas has been proved with a probable reserve of about 300 million cubic meters (Aryal, 1996). The gas consists of mainly methane (75-80%) and carbon dioxide (14-23%) and the average calorific value is 7,200 kcal per cubic meter. The proved reserve is estimated to supply the gas for about 50 years for 20,000 to 30,000 families. This deposit is likely to be commercially exploited in near future.

#### *Coal*

Since long, coal has been known to occur in Nepal. They occur in small amount throughout the country in the Siwaliks (Churia Range) and in Lesser Himalaya including Kathmandu Valley. Presently small scale mining is going on in the Kathmandu Valley and mid-western Nepal. In the Kathmandu Valley, a low quality coal called lignite occurs as thin layers within the sediments of the Valley. The important locations are Lukundol in the south and Pharping, Kapan and Gokarna areas (ESCAP/DMG, 1993). The lignite is mixed with the imported high quality coal and used in mainly brick kilns.

Small scale mining of coal by some private parties in the mid-western Nepal around Tosh, Seuja, Abhidhara and Ajimara etc. of Dang area (in the Lesser Himalayan Zone) has been a commercial success. The production in the Tosh and Seuja areas alone amounts to about 200 tons per day. The Department of Mines and Geology is going to carry out detailed investigation of the coal deposits in the area. So far the coal occurrence in the Barahakshetra and Kampughat area in eastern Nepal, lying within the Lesser Himalayan Zone, did not show promising results. However, more detailed works are needed in these areas too.

The presence of small and irregular deposits of low quality coal in various geologic formations of Siwaliks and Lesser Himalayan zones indicate that some of the small scale mining of these deposits may continue for some years to come and some new small deposits may



be found, but finding of large and good quality coal deposits in Nepal seems to be less probable.

#### **Construction materials**

Nepal is rich in construction materials such as aggregates, roofing slate, paving stone, building blocks and sand which can be derived from bed rocks in the mountain, river beds and river terraces. These materials are available throughout the country. In the future, one of the most important export items of Nepal can be the construction materials. Bangladesh and Northern India make-up an unlimited market. The inadequate policy on the export of these materials has not allowed to bring the maximum benefit to the nation from these exports. Presently, the export price of these materials are almost negligible. No thorough studies on the environmental impacts on the major source areas are carried out and potential sources are delineated. Presently, the major export item in this category is the boulders from the major River beds and streams originating from the Churia hills. If a policy is made to stop boulder export and allow export of only the secondary products like aggregates (crushed stones), Nepal can tremendously benefit in terms of job creation and enhanced value of the material.

#### **Others**

In addition to the above mentioned mineral deposits, occurrences of other metallic minerals such as cobalt, nickel, tungsten, and tin, and non metallic minerals like talc, mica, phosphorite (used for production of chemical fertilisers), common salt, silica sand (used for glass industries), red clays (used for cement production), clays for brick manufacture, kaolin (used as clay for ceramic industries), etc. are also reported from different parts of the country, and investigation of some of these deposits show promising results.

### **CONCLUSIONS**

Geology is a science which deals with the earth as a whole and its materials. Exploration of useful earth materials such as mineral deposits needs long term research and investment. In that respect, it is different from technology of making roads, bridges or dams which can be planned and applied and the impressive and visible result can be achieved in a relatively short time. The last three decades of geological research in Nepal with a handful of geoscientists is only a modest

beginning when compared with the history of geological research of over 150 years even in our neighbouring countries. Geological research and mineral exploration in a country is a continuous process. New knowledge and insights are added by every new research which helps further to locate and exploit new mineral resources.

In general, the policy makers, bureaucrats, and the general public in Nepal have not fully realised the contribution of the mineral based industries and the importance of geoscientific studies in the economic growth and in the development activities of the country. Unfortunately, in the early sixties a vague notion was introduced by some foreign geologists and now widely ingrained in the minds of every body in the country: the notion that the Himalaya is a young mountain and does not contain any mineral deposit -therefore, investment in geologic research and mineral exploration is not worth. This notion is strongly prevalent even today if we see the investment trend that is made in the geoscientific research and mineral exploration work in Nepal.

In the last 30 years, Nepal has spent in total only about 280 million rupees (approximately 5 million US dollars) for its mineral resources development. This includes administrative cost, salaries and developing physical facilities like buildings etc. (DMG, 1996). In recent years, many departments of HMG have their annual budget much more than this total figure. Currently, the total annual revenue that some of the larger mineral based industries pay to the government exceeds the total amount spent in the last 30 years. In the 1994/1995 fiscal year the mineral sector contributed 0.64% of the total national income which is a significant contribution. If we also consider the contribution of this sector in reducing imports and thereby saving foreign exchange (e.g. cement etc.), the cumulative positive impact on the national economy is tremendous.

The trend of investment in the mineral sector leads to the conclusion that Nepal has generally neglected the development of mineral sector in the past. Despite of this, the contribution of mineral sector in the economic development of the country is impressive and commendable. The geoscientists of the country must be given credit for this achievement. The prevailing wrong notion about the mineral potential of Nepal must be cleared from the minds of the policy makers and all others.

Adequate budgetary allocations should be provided to the concerned department if a balanced development in the mineral sector is to be expected. The present author strongly feels that the Department of Mines and Geology has to be strengthened both in manpower and budgetary allocation. The usual tendency of the government to demand immediate results and achievements for each rupee spent from a basically research oriented organisation like the Department of Mines and Geology has to be changed.

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# Phosphorite exploration in Nepal

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Phosphorite is one of the very important raw materials to manufacture chemical fertilizers such as Tripple Super Phosphate (TSP) and Fused Magnesium Phosphate (FMP). Present demand of chemical fertilizer in Nepal is about 100,000 metric tons per year. There is no chemical fertilizer industry in the country and all the demand is met by import. In this context, exploitation of some economically and technically viable phosphorite deposits in the country and setting up of fertilizer industries can play a vital role in the economic development of Nepal.

His Majesty's Government of Nepal included the phosphorite exploration programme only from the fourth five years plan and the Department of mines and Geology initiated the preliminary phosphorite exploration activities in 1967. Systematic exploration continued mainly in the selected areas till 1984. This work was successful to locate a few promising areas for low to medium grade (with large tonnage) phosphorite deposits in Baitadi, Bajhang, Bajura areas of Far Western Nepal and a few occurrences in the vicinity of Main Boundary Thrust (MBT) in eastern and central Nepal, and Eocene Rocks of Dang area.

Phosphorite Prospects/deposits in Dhik Gad, Jhunikuna, Morgaon, Sanagaon, and Dhaubisame areas in Baitadi District are the medium grade and high tonnage phosphorite deposits in Nepal. Here the phosphorite horizon is 0.7 to 4.7 m thick and confined to massive cherty dolomite of Precambrian to Lower Paleozoic age (Bashyal, 1981). The phosphorites are mainly stromatolitic, sandy and pelletal type. They are generally associated with chert. The phosphorite consists of 5 to 32%  $P_2O_5$ . However, detail exploration work is warranted to confirm the actual grade and tonnage of the deposits.

In Bajhang District, similar stromatolitic phosphorite mineralization bands are recorded at Tarugad, Juilgad and Goichan, Kandecharu areas (Pradhananga, 1984). It is the eastward extension of Baitadi phosphorite zone. Their thickness varies from 1 to 23 m and  $P_2O_5$  content varies from <5% to 20%. Similar type of phosphorite horizons (about 2 m thick) are also traced in Bajura. They contain about 4%  $P_2O_5$  in average.

Dark gray to brownish black detrital phosphorite fragments (<1mm to 1 cm size) are known from fossiliferous argillaceous limestone lenses and beds exposed in Sewar Khola in Dang district and in Mari Khola section in Piuthan district. The  $P_2O_5$  content in these phosphatic rocks is normally below 5% and rarely up to 10%. However, analysis of only the phosphorite fragments revealed up to 25%  $P_2O_5$  in them.

Phosphorite exploration in the vicinity of the MBT was able to trace some of the phosphatic rocks at Takure, Barahakshetra, Tawakhola areas in Eastern Nepal, Gawar Khola, Sewar Khola in Mid Western Nepal and in Khulia Khola section in Far Western Nepal (Kaphle, 1977).

Out of these occurrences, only the phosphorite of Baitadi area appears to be promising. Phosphatic rock samples from Jhunikuna (Baitadi) was analyzed by the International Fertilizer Development Center (IFDC), Alabama, USA. According to the report, the ore samples consist of Apatite (42-44%), Dolomite (35-37%), Quartz (10%), Calcite (13-14%) and opaque minerals (<5%). Phosphate mineral has a high theoretical  $P_2O_5$  content (40.5%) in a 100% apatite concentrate. Chemical analysis of the rock phosphate sample revealed  $P_2O_5$  = 17.4%,  $CaO$  = 42.6%,  $SiO_2$  = 10.1%,  $MgO$  = 8.2%,  $Fe$  = 1.5%,  $Na_2O + K_2O$  = 0.09%,  $R_2O_3$  = 0.07%, LOI (at 1000°C) = 22.3%. The preliminary laboratory work has indicated that this phosphorite is relatively low grade and  $MgO$  content is very high (8.2%).  $CaO/P_2O_5$  weight ratio is high (2.41) due to the presence of dolomite and calcite. For the production of phosphoric acid by wet process, the  $MgO/P_2O_5$  weight ratio of the rock phosphate should not exceed 0.022. Neutral Ammonium Citrate (NAC)-soluble  $P_2O_5$  is 1.1. It indicates that the reactivity of this rock phosphate is very low. Therefore, the ore has a low industrial and agricultural value. Because of low  $P_2O_5$  and low solubility of the apatite mineral, the ore has a low potential for direct application in the agricultural fields. Large amount of unwanted gangue minerals have to be removed during the process of upgrading (beneficiation). It will have to be grinded to a very fine mesh size and to be

treated (partial acidulation) with either  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$  to increase  $\text{P}_2\text{O}_5$  (Citric Acid) solubility. Calcination may be the other alternate process. With a view to upgrade this phosphorite ore, a few beneficiation and solubility tests were carried out in the Department of Mines and Geology as well as in the IFDC, Alabama, USA and in Netherlands Billiton Research B.V. All the laboratory tests have indicated that Baitadi phosphorite is of low grade and it has got low reactivity (solubility). Heavy media separation is the only method by which it can be upgraded. However, Netherlands Billiton Research B.V. has recommended for a large scale laboratory testing for Fused Magnesium Phosphate and partial acidulation of phosphate rocks. If the upgrading of this Baitadi phosphorite by a suitable beneficiation technique is possible and manufacture of Fused Magnesium Phosphate is suitable, then further detail exploration and evaluation of this deposit is highly justified.

On the basis of known geological setting and lithofacies, phosphorite exploration program must be extended in similar Precambrian-Paleozoic stromatolitic carbonate rocks known in (i) Rukum-Jajarkot area (ii) Kalikot-Dailekh-Jumla area and (iii) Gulmi-Baglung area on

priority basis. It may be able to identify some economically viable phosphorite deposits. Therefore, large scale industrial (laboratory) test of already known Baitadi phosphorite and exploration of phosphorite in new suitable areas is warranted in near future.

To establish a fertilizer industry for Fused Magnesium Phosphate, it requires fairly high grade phosphorite and magnesite as the two main raw materials and high amount of electricity. Few magnesite bands (1 to 4 m thick) are also recorded in nearby areas in the Baitadi District. Besides, high grade magnesite is available in Kharidhunga in Central Nepal. Necessary electricity can be obtained from different sources. Access road of about 30 km length to link the deposit with the Dadeldhura-Baitadi-Darchula Highway from Patan or from Dhikgad (about 8 to 12 km) has to be constructed. However, this industry can be feasible only after the discovery of high grade phosphorite in the country. Therefore, further exploration of phosphorite, if necessary, with the help of foreign assistance, with a view to establish a FMP or TSP industry in Far Western Nepal is warranted. It will not only help in agricultural sector, but also generate employment and boost the economy of the country.

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# भूकम्प प्रकोप

माधव राज पाण्डे

राष्ट्रिय भूकम्प मापन केन्द्र, खानी तथा भूगर्भ विभाग  
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परापूर्वकालदेखि मानव समाजले भोग्दै आउनु परेको दैवी प्रकोपहरू मध्ये सबभन्दा खतरनाक, विनासकारी, व्यापक तथा नियन्त्रण गर्न कठिन भूकम्प प्रकोप हो। यो प्रकोप कुनै स्थानबाट अकस्मात शुरू भै क्षणभरमै असंख्य घन, जनको क्षति गर्दै यति छिटो प्रसारण हुन्छ कि भूकम्प भइरहेकै समयमा व्यक्तिगत स्तरमा केही सामान्य कुराहरूको पालना गर्नु सिवाय अन्य उद्धार कार्यको प्रयास संभव हुँदैन। अर्कोतिर विश्वसनीय तथा व्यवहारिक पूर्व सूचनाका पद्धतिको अभावले गर्दा अग्रिम चेतावनी गरी घनजनको क्षति घटाउन पनि सम्भव भएको छैन। भूकम्पनबाट प्रभावित हुन सक्ने स्थानहरू तथा भूकम्पनबाट उत्पन्न हुने शक्तिको मात्राको लेखाजोखा गरी तदनुसार अग्रिम रूपमै विभिन्न औद्योगिक तथा आवास भवन संरचनाहरूलाई भूकम्प प्रतिरोधक बनाउनु सबभन्दा प्रभावकारी हुन जान्छ। यद्यपि विभिन्न स्थानहरूमा संभावित भूकम्पनको शक्तिको वास्तविक लेखाजोखा गर्ने कार्य अति जटिल र महंगो हुनुका साथै लामो समयसम्मको वैज्ञानिक अवलोकन (Observation) तथा अनुसन्धानको आवश्यकता पर्दछ।

भौगर्भिक कारणबाट उत्पन्न हुने दैवी प्रकोपहरू ज्वालामुखी, पहिरो, भूकम्प इत्यादि हुन्। पृथ्वी भित्रको आन्तरिक प्रकृयाबाट उत्पन्न यान्त्रिक शक्ति कुनै खास स्थानहरूमा संचित हुँदै जान्छन् र कुनै सिमासम्म पुगेपछि भूकम्पनबाट क्षिण (Release) हुन्छन्। शक्ति संचित हुने स्थानहरू साधारणतया: दुई Tectonic Plate को सिमानाको परिवेशमा हुन्छ। उदाहरणार्थ दक्षिणमा अवस्थित Indian Plate ले उत्तरतिर जान खोज्दा उत्तरमा रहेको Tibetan Plate को सिमानाको परिवेशमा पर्ने हिमालयको विभिन्न स्थानहरूमा भूकम्प उत्पत्ति गर्दछ। यसले दुई भौगर्भिक प्लेटको सिमानामा पर्ने क्षेत्रमा सधैं भूकम्पको प्रकोपको डर हुने हुँदा यस्तो ठाउँमा बस्ने मानिसहरूमा यस प्रकोप सम्बन्धी पूर्व चेतना हुनु नितान्त आवश्यक देखिन्छ।

भूकम्पबाट हुने विनास सर्वप्रथम भूकम्पनबाट हुन गएको यान्त्रिक शक्ति क्षिण (Elastic Energy Released) मा भर पर्दछ। क्षिण शक्तिको परिमाण भूकम्पको म्याग्नेच्युड (Magnitude) ले दर्शाउँछ। अतः जति ठूलो म्याग्नेच्युड भयो उति ठूलो र व्यापक विनास हुन्छ। साधारणतया: ४ म्याग्नेच्युडका भूकम्पभन्दा साना भूकम्पहरू मानिसहरूले महसूस गर्दैनन्। यद्यपि उपकर णहरूले भने १ भन्दा साना म्याग्नेच्युड पनि रिकर्ड गर्दछन्। जति ठूलो म्याग्नेच्युड भयो उति टाढासम्म महसूस हुन्छ। ६.५ म्याग्नेच्युडको भूकम्पको केन्द्र बिन्दूबाट १००० कि.मि. सम्म पनि महसूस भएको देखिन्छ।

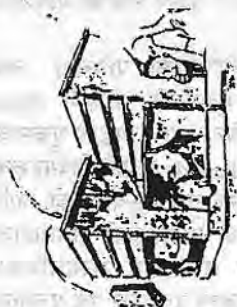
हानी नोक्सानी भने ५ म्याग्नेच्युडसम्मको भूकम्पले पनि कहिँ कहिँ गरेको रिपोर्ट पाइन्छ तापनि ६ म्याग्नेच्युडभन्दा साना भूकम्पहरूले व्यापक हानी नोक्सानी विरलै गर्दछन्।

नेपालको सन्दर्भमा कुरा गर्दा धेरै पुराना ऐतिहासिक भूकम्पहरूको बारेमा खास आँकडा नभएता पनि वि.सं. १८९० (७.८ म्याग्नेच्युड), १९९० (८.३ म्याग्नेच्युड) का महाभूकम्पहरू २०३७ सालमा (६.५ म्याग्नेच्युड इपीसेन्टर बझाङ) र २०४५ मा (६.५ म्याग्नेच्युड-इपीसेन्टर उदयपुर) का मझौला भूकम्पहरू उदाहरणको लागि उल्लेखनिय छन्। १८९० को भूकम्पले मध्य नेपाल र काठमाडौं उपत्यकाको अत्यधिक विनास गरेको थियो भने १९९० सालको महाभूकम्पले पूर्वमा दार्जिलिङदेखि पश्चिममा नुवाकोटसम्म र उत्तरमा ताप्लेजुङदेखि दक्षिण बिहार प्रान्तसम्म हानी नोक्सानी पुऱ्यायो। यस क्षेत्रभित्र अत्यधिक विनास भएको टापु आकार स्थानहरू विद्यमान छन् भने दक्षिणको तराई मैदान र काठमाडौं उपत्यकांमा अत्यधिक घनजनको नोक्सानी भएको थियो।

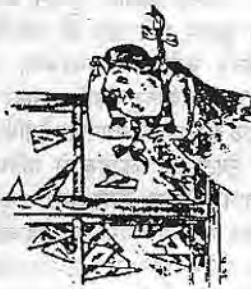
एकातिर साना साना भूकम्पहरू तथ्यांकको मानेमा (Statistical Sense) निरन्तर उत्पन्न भैरहेका हुन्छन् भने अर्कोतिर जति ठूलो परिमाणको भूकम्प भयो उति धेरै वर्षपछि दोहोरिन्छन्। उदाहरण स्वरूप कतिपय स्थानहरूमा ७ म्याग्नेच्युडको भूकम्प करिब १५० वर्षपछि दोहोरिन सक्छ। यस्तो दोहोरिने अवधि भूकम्पकारक संरचनाको स्थानीय भौगर्भिक अवस्था तथा कृशील रहेको टेक्टोनिक प्लेटहरूको गतिमा निर्भर गर्ने हुँदा बेग्ला बेग्लै स्थानमा बेग्ला बेग्लै हुन्छ। कुनै पनि स्थानको भूकम्प प्रकोप सूचक निर्धारण गर्नमा यस दोहोर्याई अवधि (Recurrence Period) प्रयोग गरिन्छ। उपरोक्तको अलावा प्रत्येक भूकम्पकारक संरचनाको कुनै सिमागत म्याग्नेच्युड उत्पादन गर्न सक्ने क्षमता हुन्छ। (Earthquake Potential) जस भन्दा ठूलो भूकम्प त्यस भौगर्भिक संरचनाको उत्पादन गर्दैन। यसको मूल्याङ्कन समेत भूकम्प प्रकोप सम्बन्धी अध्ययनमा समावेश गरिनु पर्दछ।

यसरी भूकम्प जाने संरचनाको पहिचान, त्यस संरचनामा उत्पन्न हुनसक्ने भूकम्पको परिमाण (Size) अर्थात् सिमागत म्याग्नेच्युड, विभिन्न म्याग्नेच्युडको भूकम्पको पुनरावृत्ति अवधि (Recurrence Period) इत्यादि विषयहरूको जानकारी भूकम्प प्रकोपको मात्राको मूल्याङ्कनको लागि अत्यावश्यक कुराहरू हुन्। यी प्रश्नहरूको समाधानको लागि सेस्मलजिकल आँकडा संकलनार्थ सेस्मलजिकल स्टेशनहरू संचालन गरिन्छ। भूकम्प प्रकोपको पूर्व सूचनाका

# PROTECT YOURSELF FROM EARTHQUAKES



TAKE COVER UNDER A DESK.



DO NOT GO NEAR THE WINDOWS.



STAY CLEAR OF COLLAPSED BUILDINGS.



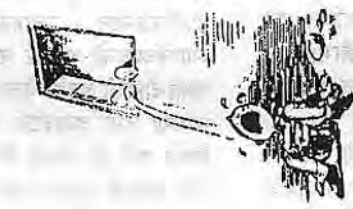
DO NOT STAMPEDE THE EXIT.



TAKE COVER UNDER A TABLE.



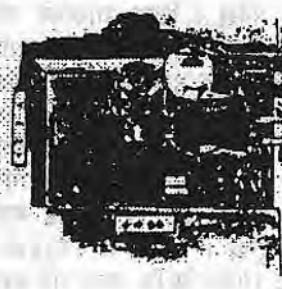
TAKE COVER UNDER A BED.



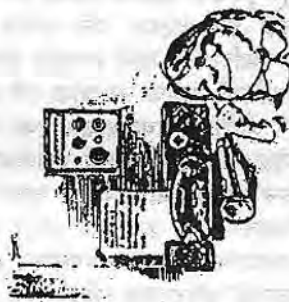
DO NOT JUMP OUT OF A WINDOW.



DO NOT STAND ON A BALCONY.



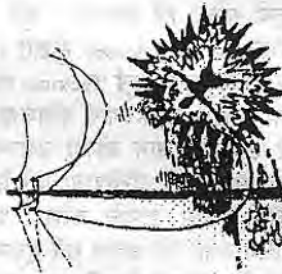
DO NOT USE LIFT



KEEP READY, FLASH LIGHT, RADIO,



STAY UNDER A DOOR.



DO NOT STAY UNDER THE HIGH TENSION LINE.

भूकम्पको समयमा र तत्काल पछि निषेध गरिएका कुराहरू

दीर्घकालिन सूचकहरू पनि यिनै हुन् । योजनाकार तथा अन्य निर्णयकर्ताहरूले पनि यिनै दीर्घकालिन सूचकहरूका पूर्व चेतनाबाट यस प्रकोपको दीर्घकालिन नियन्त्रणमा प्रभावकारिता हासिल गर्नु पर्ने हुनजान्छ ।

कुनै खास क्याशील भौगर्भिक संरचनामा भूकम्पको उत्पत्ति हुने हुँदा त्यस संरचनाबाट जति टाढा गयो उति भूकम्पको जोड कम हुनजान्छ र भूकम्प प्रकोप पनि तदनुसार नै प्रतिबिम्बित हुन्छ । वास्तवमा भन्ने हो भने भूकम्प प्रकोपको मात्रा अनुसार क्षेत्रलाई "भूकम्प प्रकोपान्चल" (Earthquake zone) मा विभाजन गर्दा मुख्यतया माथिका दुई कुराहरूमा आधारित गरिन्छ- संरचनामा उत्पत्ति हुनसक्ने सिमागत भूकम्पको परिमाण र त्यस संरचनाको सम्बन्धित स्थानबाट दूरी । भूकम्पबाट संरचनाको क्षिण भएको शक्ति म्याग्नेच्युडले देखाउँछ भने त्यसबाट उत्पन्न कम्पनको मात्रा भने Intensity ले दर्शाउँछ । इन्टेन्सिटी साधारणतया: १ देखि १२ सम्मको मोडिफाइड मर्सेली स्केल (MM) मा नापिन्छ । यसैले इन्टेन्सिटी भूकम्पकारक संरचनाको नजिकै सबभन्दा बढी भई चारैतिर घट्दै गएको हुन्छ । यद्यपि स्थानीय भौगर्भिक कारणले गर्दा Micro scale मा ठाउँ ठाउँमा बढी Intensity पैदा हुन जानसक्छ । उदाहरणको लागि गत: १९९० सालको म्याग्नेच्युड (८.३) महाभूकम्पमा अधिकतम इन्टेन्सिटी X MM थियो भने २०३७ सालको बझाङ्ग भूकम्प (६.५) र २०४५ सालको उदयपुर भूकम्प (६.५) मा अधिकतम इन्टेन्सिटी VII MM मूल्याङ्कन गरिएको छ ।

स्थानीय भौगर्भिक तथा भौगर्भिक अवस्थाले पनि त्यस ठाउँमा भूकम्प जाँदा उत्पन्न हुने इन्टेन्सिटी अर्थात् संभावित बिनासको मात्रा निर्धारण गर्दछ । एक हिसाबले लेक अर्थात् पहाडमा भन्दा बेसी अर्थात् उपत्यकाहरूमा बढी कम्पन हुनजान्छ । खासगरी माटोको बाक्लो तह भएको उपत्यका र बेसीहरूमा कम्पनको जोड निकै हुन्छ । गत: १९९० सालको महाभूकम्पनमा काठमाडौँ उपत्यकाको बिनासमा मुख्यतया: यही माटोको असरले गर्दा हो भन्ने कुरा सिद्ध भएको छ भने २०३७ सालको बझाङ्गको भूकम्पबाट भएको बिनास पनि बेसी अर्थात् उपत्यकाहरूमा बढी भएको देखिन्छ । यस दृष्टिकोणबाट पहाडको मध्य भाग (स्लोप) मा कम्पन कम हुने हुँदा बिनासको सम्भावना कम हुन्छ ।

भूकम्पबाट उत्पन्न हुने जमिनको अबाञ्छनिय परिवर्तन मध्ये सबभन्दा असर गर्ने पहाडी क्षेत्रमा पहिरो र उपत्यका, मधेश र तराई खण्डमा जमिनको तरलीकरण (Liquifaction) हो । भूकम्पले पहाडी क्षेत्रमा पुराना पैराहरूलाई क्याशील गर्नुका साथै नयाँ पहिरोहरू समेत उत्पन्न गर्न सक्दछ । वर्षाको याममा सानो भूकम्प (करिब ४ रिक्टर स्केल) ले पनि पहिरो चलाएको पाइन्छ । ठूलो भूकम्प पश्चात् जाने साना साना भूकम्पहरूले पैराहरू निरन्तर चलाइरहेको उदाहरण १९९० सालको भूकम्पमा देखिन्छ । वर्षा याममा सानो भूकम्पबाट चलेको पहिरोले नदीलाई रोकी उत्पन्न गरेको ताल फुट्दा बाढीले ठूलो बिनास गरेको पनि पाइन्छ ।

उपत्यका वा भित्री मधेश वा तराई खण्डमा प्रायः बलौटे माटोको बनावट भएको जमिनको अवस्थामा भूकम्पनको प्रवेगले जमिनमा रहेको पानीको दबाव बढाउँदै लान्छ । बलौटे माटोको अवस्था तथा भूमिगत पानीको गहिराई हेरी माटोले आफ्नो बोझ बहन गर्न सक्ने शक्ति (Bearing capacity) बढ्दो दबावको प्रभावमा परी गुमाउन सक्छ । यसलाई माटोको तरलीकरण (Liquifaction) भनिन्छ । माटोको बहन गर्ने शक्तिको बिनासका साथै त्यसमाथि रहेका घर, स्कूल, बाटो, पुल, रेलको लिग इत्यादि संरचनाहरूको आंशिक वा पूर्ण बिनास हुन्छ । वास्तवमा भन्ने हो भने १९९० सालको र गत: २०४५ सालको भूकम्पबाट सबभन्दा बढी बिनास यही प्रकृया अन्तर्गत भएको देखिन्छ । कहिलेकाँही बालुवाको धारो जमिनबाट बाहिर निस्की सयौं हेक्टर जमिनमा फैलिई कृषियोग्य जमिनलाई नष्ट गरिदिन्छ । योजनास्थलमा यस प्रकृयाको सम्भावनाको लेखाजोखा गर्न माथि उल्लेखित भूकम्प सम्बन्धी सूचकको अलावा माटो सम्बन्धी सूचकहरू र पानीको गहिराई समेतको जानकारीको आवश्यकता पर्दछ । योजनाबद्ध रूपमा समतल भूमिमा तरलीकरण सम्भावित क्षेत्रहरू रेखाङ्कन गर्दै जानु पर्ने र त्यस्तै नगर क्षेत्र तथा ग्रामिण क्षेत्रमा विभिन्न निर्माण परियोजना तर्जुमा गर्दा यस प्रकोपको समेत विचार गरिनु पर्ने आवश्यकता देखिन्छ ।

व्यक्तिगत तथा सामूहिक स्तरमा भूकम्पको समयमा र भूकम्पन पछिका केही दिनहरूमा के कस्तो कुराहरूमा ख्याल राख्नु पर्ने हुन्छ सो सम्बन्धी केही छलफल गर्नु उचित देखिन्छ । अल्पकालिन परिधिभित्र भूकम्प भविष्यवाणी गर्न सक्षम वैज्ञानिक विश्वशानिय पद्धतिको विकास अझै भएको छैन । अपितु कुनै कुनै भूकम्प अघि पूर्व कम्प गएको देखिन्छ । यस्तो पूर्व कम्प केही मिनेटदेखि केही दिनसम्म पनि गएको पाइन्छ । यद्यपि सबै भूकम्पको अगाडि पूर्व कम्प गएको देखिँदैन । पूर्व कम्प र मुख्य भूकम्पको बीच करीव अर्धघण्टा फरक भएको उदाहरण निकै नै देखिएको हुँदा कुनै पनि भूकम्प अनुभव भएपछि करिब ३ घण्टा चनाखो भइ बसेमा कुनै हदसम्म बढी सुरक्षित भई प्रकोपबाट कुनै बिनासलाई कम गर्न सकिन्छ । व्यक्तिगत या पारिवारिक स्तरमा यसभन्दा बढी समय चनाखो भइरहन गाह्रो हुन जानसक्छ तर दैवी प्रकोप नियन्त्रण प्रकृत्यामा संलग्न संगठनहरूले भने ३ दिनसम्म चनाखो रहँदा बेस हुन्छ ।

त्यस्तै ठूलो भूकम्प पश्चात् अलि सानो परिमाणका परकम्प (Aftershocks) हरू पनि जान्छन् । मुख्य भूकम्पले चर्काएको घरलाई यी भूकम्पहरूले ढवस्त पारेको देखिन्छ । यसैले ठूलो भूकम्प तत्कालै चर्केको घरहरू छोडि सुरक्षित स्थानहरूमा रहनु अत्यावश्यक हुन्छ ।

अन्त्यमा चित्र नं. १ मा भूकम्पको समयमा र तत्काल पछि निषेध गरिएका कुराहरूको उदाहरण प्रस्तुत गरिएको छ । यो ग्रिसमा गरिएको फोष्टरबाट लिइएको हो । के गर्नु हुन्न सो चित्रबाट प्रष्ट छ । आपदको बेलामा धैर्यधारण गरेमा आइपर्ने समस्यासँग लड्न सकिन्छ साथै दैवी प्रकोपको कारण त्यसको असर तथा रोकथाम सम्बन्धमा सबैले वैज्ञानिक सोचाई राखी चेतनशील भएमा यसबाट हुने नोक्सानीलाई न्यूनतम गर्न सकिन्छ । □

# ऐतिहासिक भूकम्पहरू र नेपालमा भूकम्पीय जोखिमको न्यूनीकरण

महेश नकमी

आवास तथा भौतिक योजना मन्त्रालय  
सिंहदरबार, काठमाडौं

कुनै पनि घटनाबाट जनघनको क्षति हुन्छ भने त्यस्तो घटनालाई प्रकोप भनिन्छ। त्यस्तै प्राकृतिक घटनाबाट जनघनको क्षति हुन्छ भने त्यस्तो घटनालाई प्राकृतिक प्रकोप भनिन्छ।

विश्वमा हुने विभिन्न प्राकृतिक प्रकोपले गर्दा विश्वका मानव समुदायले समय समयमा जनघनको क्षति भोग्नु परेको छ। यस्ता प्राकृतिक विपत्तिका घटनाहरू विगतमा भएका भन्दा तत्कालीन वा निकटवर्ती समय र स्थानमा भएका घटनाबाट बढी प्रभावित हुने गर्दछन्। साथै सो घटनाले परेको बिनाश र क्षतिको परिमाण पनि उक्त घटना दीर्घकालीन समयसम्म सम्झना रहिरहने हुन्छ। संयुक्त राष्ट्रसंघको तथ्याङ्क अनुसार गत बीस वर्षमा घटेका प्राकृतिक प्रकोपको घटनाबाट करीब तीस लाखको मृत्यु र ८० करोड जनता प्रभावित भएका छन्। यस मध्ये हाफ्रो यस एशिया प्रशान्त क्षेत्रमा करीब ८० प्रतिशत प्राकृतिक प्रकोपका घटनाहरू भइरहेका छन्। सन् १९०० देखि १९९६ सम्म यस्ता घटनाहरूबाट भएका मृत्युको विवरण तालिका १ मा प्रस्तुत गरिएको छ।

तालिका-१ मा उल्लेख भए अनुसार सन् १९०० देखि हालसम्मका मुख्य प्राकृतिक प्रकोपका घटनाहरू मध्ये ५० प्रतिशत घटना भूकम्पकै भएको देखिन्छ। यस तथ्यबाट प्राकृतिक प्रकोपहरू मध्ये भूकम्प एक मुख्य प्राकृतिक प्रकोप मान्न सकिन्छ। तसर्थ यस लेखमा भूकम्पीय प्रकोप (Earthquake Disaster) लाई विवेचना गरिएको छ।

## भूकम्प एक प्राकृतिक प्रकोप

प्रत्येक वर्ष विश्वमा करीब तीन लाखभन्दा बढी भूकम्प जाने गर्दछ। भाग्यवश ती मध्ये धेरैजसो भूकम्पहरू यात कम शक्तिशाली हुन्छन् अथवा ती मानव बसोबास नभएको क्षेत्रमा हुने गर्दछन्। जसले गर्दा जनघनको क्षति भएको हुँदैन तर ती मध्ये केही धेरै शक्तिशाली र धेरै घटक दोहोरी राख्छन्। तसर्थ भूकम्पको आफ्नै किसिमको चरित्र हुन्छ। यसरी विश्वमा हुने प्राकृतिक प्रकोपहरू मध्ये सन् १९०० देखि सन् १९७६ सम्मको तथ्याङ्क विश्लेषण गर्दा कुन प्राकृतिक प्रकोपबाट कति मृत्यु भयो भन्ने आँकडाको प्रतिशत तालिका २ मा प्रस्तुत गरिएको छ।

तालिका २ बाट प्राकृतिक प्रकोपहरूमध्ये भूकम्पबाट धेरै मान्छेको मृत्यु हुन्छ भन्ने तथ्य प्रष्ट हुन्छ। यसरी नै प्राकृतिक प्रकोपका घटनाहरू भएका देशहरूको तथ्याङ्क विश्लेषण गरी प्राकृतिक प्रकोपबाट जोखिम रहेका देशहरूको

तथ्याङ्क तालिका ३ मा प्रस्तुत गरिएको छ।

माथिको तथ्याङ्कबाट पनि भूकम्पीय प्रकोपबाट खतरामा रहेका देशहरूको संख्या अन्य प्रकोपभन्दा बढी देखिन्छ। यसरी खतरामा रहेका देशहरूमा विगतमा गएको ऐतिहासिक भूकम्पको विषयमा पनि केही चर्चा गर्नु प्रासंगिक हुनेछ।

## विश्वका ऐतिहासिक भूकम्पहरू

विश्वमा सन् ५२६ मई २० तारिखका दिन सिरियाको एण्टिकहमा गएको भूकम्प विश्वको पहिलो महा-भूकम्प भएको कुरा अभिलेखमा पाइएको छ। हुन त यो भन्दा अगाडी पनि भूकम्प गएको जानकारीमा आएको छ तर तथ्य प्रमाण प्राप्त नभएकोले यहाँ दिइएको छैन। सो पहिलो महा-भूकम्पबाट २ लाख ५० हजार मानिसको ज्यान गएको थियो। त्यो भूकम्पको क्षमता कतिको थियो, सो को अभिलेख भने पाइएको छैन। हालसम्मको सबभन्दा ठूलो महा-भूकम्प सन् १५५६ जनवरी २३ मा चीनको शान्शी, हुनान प्रान्तमा गएको थियो। सो महा-भूकम्प ८.० रेक्टर स्केलको थियो। उक्त महा-भूकम्पले ८ लाख ३० हजार मानिसको ज्यान लिएको थियो। यसरी नै दोश्रो ठूलो महा-भूकम्प सन् १७३७ अक्टोबर ११ का दिन भारतको कलकत्तामा गएको थियो। उक्त भूकम्पले ३ लाख मानिसको ज्यान लिएको थियो। तर सो भूकम्पको क्षमताको अभिलेख पाइएको छैन।

यी भए केही शताब्दी अघिको भूकम्पीय इतिहास। तर यही शताब्दीमा हाफ्रो जीवनकालमा आजभन्दा २० वर्ष अघि सन् १९७६ जुलाई २८ का दिन चीनको हेबेइ, ताङ्गशान प्रान्तमा पनि ७.८ रेक्टर स्केलको महा-भूकम्प गएको थियो। यस महा-भूकम्पबाट २ लाख ४२ हजार ८ सय मानिसको मृत्यु भएको थियो। यो यस शताब्दीको हालसम्मको सबभन्दा ठूलो महा-भूकम्प मानिन्छ। यस्तै चीनकै निङ्गशियामा सन् १९२० डिसेम्बर १६ मा ८.६ रेक्टर स्केलको महा-भूकम्प गएको थियो। यसबाट २ लाख २० हजार मानिसको ज्यान गएको थियो। यसरी नै सन् १९२३ सेप्टेम्बर १ मा जापानको क्वान्तो क्षेत्रमा गएको ८.२ रेक्टर स्केलको अर्को महा-भूकम्प हो। यो महा-भूकम्पबाट १ लाख ४२ हजार ८ सय ७ जनाको मृत्यु भएको थियो। यस भूकम्पबाट सागामी खाडीको एक भाग समुद्रको ४ सय मिटर तल धसिएको थियो। सन् १५०० देखि १९९२ सम्मको भूकम्पीय तथ्याङ्क हेर्दा जम्मा ११ सय १९ वटा भूकम्प गएको अभिलेख पाइन्छ। यस अभिलेखमा २५ जना मरेकोसम्मलाई समावेश गरिएको

तालिका १  
केही मुख्य प्राकृतिक प्रकोपहरू र त्यसबाट भएको मृत्यु विवरण (सन् १९००-१९९६)

सि.नं.	वर्ष	प्राकृतिक प्रकोप	देश	मृत्यु	कैफियत
१	१९००	हुरी बतास	अमेरिका	६,०००	
२	१९२०	भूकम्प/पहिरो	चीन	२००,०००	
३	१९२३	भूकम्प/आगलागी	जापान	१४३,०००	
४	१९३१	बाढी	चीन	३७,००,०००	
५	१९३२	भूकम्प	चीन	७०,०००	
६	१९३४	भूकम्प	नेपाल	१०,०००	
७	१९३५	भूकम्प	भारत	६०,०००	
८	१९३९	भूकम्प/त्सुनामी	चीन	३०,०००	
९	१९४८	भूकम्प	सोभियत संघ	१००,०००	
१०	१९४९	बाढी	चीन	५७,०००	
११	१९४९	भूकम्प/पहिरो	सोभियत संघ	१२,०००-२०,०००	अनुमानित
१२	१९५४	बाढी	चीन	४०,०००	
१३	१९६०	भूकम्प	मोरोक्को	१२,०००	
१४	१९६२	भूकम्प	इरान	१२,०००	
१५	१९६३	आँधी बेहरी	बंगलादेश	२२,०००	
१६	१९६५	आँधी बेहरी	बंगलादेश	१७,०००	
१७	१९६५	आँधी बेहरी	बंगलादेश	३०,०००	
१८	१९६५	आँधी बेहरी	बंगलादेश	१०,०००	
१९	१९६८	भूकम्प	इरान	१२,०००	
२०	१९७०	भूकम्प/पहिरो	पेरु	७०,०००	
२१	१९७०	आँधी बेहरी	बंगलादेश	३०,०००-५,००,०००	अनुमानित
२२	१९७१	आँधी बेहरी	भारत	१०,०००-२५,०००	अनुमानित
२३	१९७६	भूकम्प	चीन	२,५०,०००	
२४	१९७६	भूकम्प	ग्वाटेमाला	२४,०००	
२५	१९७७	आँधी बेहरी	भारत	२०,०००	
२६	१९७८	भूकम्प	इरान	२५,०००	
२७	१९८५	भूकम्प	मेक्सीको	१०,०००	
२८	१९८५	ज्वालामुखी	कोलम्बिया	२२,०००	
२९	१९८८	भूकम्प	सोभियत संघ	२५,०००	
३०	१९९०	भूकम्प	इरान	३७,०००	
३१	१९९१	आँधी बेहरी	बंगलादेश	१,४०,०००	
३२	१९९२	भूकम्प/त्सुनामी	इन्डोनेसिया	२,०८०	
३३	१९९३	भूकम्प	भारत	१०,०००	
३४	१९९३	बाढी	नेपाल	१,०००	
३५	१९९४	ज्वालामुखी	पपुवा न्यू गिनी	१,००,०००	
३६	१९९४	बाढी	चीन	१,४००	
३७	१९९४	बाढी	भारत	२,००१	
३८	१९९५	भूकम्प	जापान	५,५००	
३९	१९९६	आँधी बेहरी	भारत	४,०००	अनुमानित

तालिका २  
प्राकृतिक प्रकोपको घटनाबाट भएको मृत्युको तथ्याङ्क

सि.नं.	प्राकृतिक प्रकोपको घटना	मृत्यु (प्रतिशत)
१	भूकम्प	५८.१३ %
२	बाढी	२८.१० %
३	आँधी बेहरी/हुरी बतास	१०.६७ %
४	ज्वालामुखी	२.८० %
५	अन्य	०.३० %
	जम्मा	१००.०० %

तालिका ३  
प्राकृतिक प्रकोपको घटनाबाट जोखिममा रहेका देशहरूको तथ्याङ्क

सि.नं.	प्राकृतिक प्रकोपका घटना	देशको संख्या	प्रतिशत
१	भूकम्प	७३	४७.७६ %
२	आँधी बेहरी	२८	१८.३० %
३	ज्वालामुखी	२७	१७.६० %
४	बाढी	२१	१३.७० %
५	त्सुनामी	१८	११.८० %
६	हुरी बतास	७	४.६० %

छ। यस्तै यो शताब्दीको सन् १९०१ देखि १९९२ सम्मको भूकम्पको तथ्याङ्क हेर्दा जम्मा ४५४ वटा भूकम्पहरू गएका थिए। त्यसमध्ये चीनमा मात्र ७७ वटा भूकम्प गएको थियो। यसमध्ये ७ रेक्टर स्केलभन्दा माथिको भूकम्प जम्मा १७० वटा गएको पाइएको छ। साथै विश्वमा सबैभन्दा बढी क्षमता भएको ९.५\* म्याग्नेच्युडको भूकम्प सन् १९६० मई २२ का दिन चिलीमा गएको थियो। यसबाट ५ हजार ७ सयको मृत्यु भएको थियो।

यसरी नै दोस्रो ठूलो क्षमताको ९.२\* म्याग्नेच्युडको भूकम्प सन् १९६४ मार्च २७ का दिन अमेरिकाको अलस्कामा गएको थियो। तर भाग्यवश सो भूकम्पबाट धेरै कम अर्थात् जम्मा १ सय ३१ जनाको मात्र ज्यान गएको थियो। त्यसको मुख्य कारण सो भूकम्प कम मानव बसोबास भएको ठाउँमा गएकोले कम क्षति भएको हो।

यसरी नै विश्वका अन्य देशमा जस्तै नेपाल पनि भूकम्पजनीत प्रकोपको खतरामा रहेको देशमा पर्दछ। विगतमा नेपालमा पनि धेरै पटक भूकम्प गइसकेको छ। यसबाट धेरै नै क्षति भएको इतिहासबाट थाहा हुन्छ। तसर्थ, नेपालमा गएका ऐतिहासिक भूकम्प सम्बन्धी विवेचना गर्नु सान्दीभिक देखिएकोले संक्षेपमा प्रस्तुत गरिएको छ।

\* Moment magnitude

## नेपालका ऐतिहासिक भूकम्पहरू

विश्वका अन्य देशमा जस्तै विगतका कैयौं शताब्दीदेखि समय समयमा नेपाल पनि ठूला-ठूला भूकम्पबाट प्रभावित हुने गरेको पाइन्छ। जसको कारण असंख्य जनघनको क्षति भएको पाइन्छ। नेपालमा विगतमा गएका भूकम्पहरू मध्ये अभिलेख राखिएको सबैभन्दा पुरानो भूकम्प वि.सं. १३१० (१२१८ ?) मा गएको भूकम्प मानिएको छ। यस अघिका भूकम्पको अभिलेख पाइएको छैन।

विगतमा नेपालमा गएका ऐतिहासिक भूकम्पहरूको संक्षिप्त विवरण निम्न अनुसार प्रस्तुत गरिएको छ।

### वि.सं. १३१० को भूकम्प

वि.सं. १३१० सालको आषाढ शुक्ल तृतीया तिथि सोमबारका दिन राजा अभय मल्लको पालामा काठमाडौंमा करिव ७.७ रेक्टर स्केलको भूकम्प गएको थियो। यो भूकम्प हालसम्म नेपालमा गएको भूकम्पमध्ये पहिलो अभिलेखित हो। यस भूकम्पबाट धेरै घर, मन्दिरहरू नराम्रोसँग क्षतिग्रस्त भएका थिए। यसबाट राज परिवार सहित काठमाडौं उपत्यकाको करिव एक तिहाई जनता प्रभावित भएका थिए। यस भूकम्पमा स्वयं राजा अभय मल्लको समेत निधन भएको थियो र उत्तराधिकारी जयदेव मल्ल राजा भएका थिए। त्यसबेला करिव १५ दिनसम्म जमिन हल्ली रहेको कथन छ। यस कारणले गर्दा राज परिवार र सर्वसाधारण जनता करिव १ महिनासम्म शहर बाहिर बस्न बाध्य भएका थिए।

### वि.सं. १३१६ को भूकम्प

यो दोस्रो ठूलो रेकर्ड गरिएको भूकम्प हो। यसले गर्दा अपार जनघनको क्षति भई अनिकाल पनि परेको थियो। यो भूकम्प राजा जय देवको पालामा गएको थियो। यस्ता खालको भूकम्प राजा जयदेवको पालामा पटक पटक गएको थियो। पटक पटक गएको यस्ता भूकम्पबाट नेपालमा अनिकाल परेको कथन छ।

### वि.सं. १४६४ को भूकम्प

वि.सं. १४६४ को भाद्र शुक्ल द्वादशीको दिन राजा वृद्धाभ सिंहको पालामा गएको भूकम्पबाट ठूलो संख्यामा जनघनको क्षति भएको थियो। जसमा ठूलो संख्यामा पशुहरूको पनि ज्यान गयो। यो भूकम्पले जमिनमा ठूला ठूला भाग फुट्न गयो। यसले धेरै घरहरू, मन्दिरहरूको (रातो मच्छिन्द्र नाथको मन्दिर सहित) क्षति भयो।

### वि.सं. १७३७ को भूकम्प

सम्बत् १७३७ को पौष कृष्ण अष्टमीका दिन रातको समयमा गएको यस भूकम्पबाट अपार जनघनको क्षति भएको थियो।



**वि.सं. १७३८ को भूकम्प**

राजा श्री निवास मल्लको राज्यकालमा वि.सं. १७३८ साल जेष्ठ शुक्ल सप्तमीका दिन रातको समयमा ठूलो भूकम्प लाग्यो जसबाट धेरै घर भत्केका थिए।

**वि.सं. १८२४ को भूकम्प**

वि.सं. १८२४ आषाढ १ का दिन २४ घण्टामा २१ पटक भूकम्प गएको थियो। यसको खास जनघनको क्षतिको अभिलेख राखिएको पाइएन। तर धेरै पटक भूकम्प गएको कारणबाट अनुमान गर्न सकिन्छ कि यो पनि ठूलो भूकम्प हुनुपर्दछ।

**वि.सं. १८६६ को भूकम्प**

राजा गीर्वाण युद्ध बिक्रम शाहको पालामा वि.सं. १८६७ जेष्ठ १० दशहराका दिन भूकम्प गएको थियो। सो भूकम्पको २१ पटक धक्का महसूस गरिएको थियो। यसमा जनघनको क्षति धेरै भएको थिएन। तर धेरै घर तथा मन्दिरहरूको क्षति भएको थियो।

**वि.सं. १८८० को भूकम्प**

वि.सं. १८८० यम पञ्चमीका दिन लगभग १७ पटक भूकम्प गएको थियो। ज्योतिषिहरूले त्यसबेला सात ग्रह एकै राशीमा बसेको कारणले कुनै कडा अनिष्टको शंका गरेका थिए। तर यी ग्रहहरू छुट्टिसकेपछि सो भूकम्प गएको भन्ने अभिलेख पाइएको छ। यस भूकम्पबाट जनघनको नोक्सान कम भएको थियो। त्यसको केही महिनापछि सहरा रोगको महामारी परेको थियो।

**वि.सं. १८९० को भूकम्प**

वि.सं. १८९० आद्र १२ गते सोमबारका दिन साँझ ६ बजे ४० सेकेण्ड लामो भूकम्प गयो। त्यसपछि फेरि राति ११ बजे ठूलो भूकम्पको धक्का महसूस गरियो र तत्पश्चात् रात भरी नै करीब २३ पटकसम्म भूकम्पका धक्काहरू महसूस गरिए। यसरी नै केही दिनसम्म प्रति दिन ४० देखि ५० पटकसम्म भूकम्प गइरह्यो। यसबाट काठमाडौं उपत्यकाका शहरहरू प्रभावित भए। जसको कारण राजादेखि जनतासम्म घरबाट बाहिर निस्की खुल्ला ठाउँमा बस्न बाध्य भए। राज परिवारहरू हनुमान ढोकाभित्रको भण्डारखालमा बसे भने अरू जनताले चारैतिरका खुल्ला ठाउँमा रात बिताए। काठमाडौं उपत्यकाभित्र पनि भक्तपुर र ठिमी बढी मात्रामा प्रभावित हुन पुगे। यस भूकम्पबाट काठमाडौं उपत्यका सहित साँखु, बनेपाका अतिरिक्त उत्तरमा कुती, पूर्वमा विजयपुर, दक्षिणमा मकवानपुर र पश्चिममा गोरखासम्म नराशोसँग प्रभावित भयो।

यसको ३५ वर्ष अघि श्री ५ रण बहादुर शाहले १०० फुट अग्लो र ठूलो लम्बाई चौडाई भएको ठूलो जगन्नाथको देवालय टुँडिखेलको छेउमा बनाएका थिए। सो देवालय भूकम्पबाट भत्केर पाताल भयो। यसरी नै जनरल भीमसेन थापाले आफ्नो महल बाग दरबारको दायाँ बायाँ दुईवटा अग्ला अग्ला घरहरू बनाएका थिए। ती मध्ये एउटा पाताल भयो अर्कोको टुप्पो भाँचिएर खस्यो। यसरी नै जनरल भीमसेन थापाको महल, जनरल रणवीर सिंह थापा र जनरल माथवरसिंह थापा आदिको काठमाडौंको लगनटोलमा रहेको महल पनि भत्किए।

यो भूकम्पबाट काठमाडौं उपत्यकाको तीनवटा शहर हरूमा ४२१४ घर भत्केका थिए। यसरी देशभर १८००० घर क्षति भएको अनुमान गरिएको थियो। पाटनको बालकुमारीको मन्दिर भत्की २१ दिनपछि मात्र कुमारीको मूर्ति झिकियो र दशैमा मुकुट र कलश स्थापना गरी काम चलाई, त्यही अर्को मूर्ति फेरियो। यसरी नै सोही वर्षको असोज महिनाको १० गते राति पुनः धेरै पटकसम्म भूकम्प गएको थियो। यसैबेला आश्विन शुक्ल १५ का दिन खोला नालाहरूमा बाढी आई खेतमा रहेको अन्न पात समेत बगाई लग्यो। यस बाढीले चापागाउँको टीकाभैरवको मूर्ति समेत बगाएर लग्यो।

**वि.सं. १८९१ को भूकम्प**

वि.सं. १८९१ साल आषाढ सुदि ५ मा, भाद्र सुदि एकदशीको १३ घडी बाँकीमा आश्विन कृष्ण अष्टमी रोज ६ का दिन, २ असोज १२ रोज २ का दिन ठूलै भूकम्प गयो। यी भूकम्पहरूबाट पनि धेरै घरको नोक्सानी भए तर एक वर्ष अघि वि.सं. १८९० भाद्र १२ गते गएको भूकम्पले जति क्षति यसले पुऱ्याएन। यो भूकम्प गएको बेलामा अत्यधिक वर्षा भइरहेको थियो तर भूकम्पपछि वर्षा बन्द भयो। सो वर्षाको कारण बाग्मती नदीमा अत्यधिक बाढी आई घर खेत बगाई लगेको थियो। साथै बाग्मती माथिको पुलको पारापेट समेत भत्कियो। करिव ७ वर्षमा भत्केको बिग्रेको घर मर्मत तथा पूर्णनिर्माण कार्य पूरा भएको थियो। वि.सं. १८९६ मा श्री ५ राजेन्द्र बिक्रम शाहले पशुपति मन्दिरमा नयाँ सुनको छाना लगाएका थिए। त्यस बखत घर बनाउने निर्माण सामग्रीहरू आफ्नै देशमा तयार हुने भएकोले निर्माण कार्य पूरा गर्न धेरै समय नलागेको तथ्य अभिलेखबाट पुष्टी हुन्छ।

**वि.सं. १९७३ को भूकम्प**

वि.सं. १९७३ मा नेपालको सुदूर पश्चिमान्चलमा ठूलो भूकम्प भएको थियो भन्ने कथन छ। तर सो को अभिलेख पाइएको छैन।

वि.सं. १९८३ को भूकम्प

वि.सं. १९८३ को माघ महिनामा गएको यो भूकम्पले भारतको पटना र बिहारलाई प्रभावित पारेको थियो। यस भूकम्पले नेपालमा प्रभाव पारेको अभिलेख पाइएको छैन।

वि.सं. १९९० को भूकम्प

वि.सं. १९९० को महा-भूकम्पको ठीक १०० वर्षपछि वि.सं. १९९० मा यो भूकम्प गएको थियो। वि.सं. १९९० सालको माघ २ गते दिनको २ बजे २४ मिनेट २२ सेकेण्ड जाँदा नेपालका पूर्वी क्षेत्र चैनपुरमा केन्द्र बिन्दु भएको सो महा-भूकम्पको नाप ८.३ रेक्टर स्केलको थियो। सो महा-भूकम्पले नेपालमा पुरुष ३८५० र महिला ४६६९ गरी जम्मा ८५१९ जनाको मृत्यु भएको थियो। यस मध्ये काठमाडौँ उपत्यकामा पुरुष १९५२ र महिला २३४४ गरी जम्मा ४२९६ जनाको मृत्यु भयो। यस भूकम्पबाट घरबास, देवालय र पाटी पौवा समेत गरी जम्मा २,०७,७४० बटा भवन भत्केका थिए।

यो भूकम्पको विषयमा मेजर जनरल ब्रह्म शम्शेरद्वारा लिखित "नेपालको महा-भूकम्प" किताबमा उल्लेख भएको छोटो वयान यहाँ प्रस्तुत गरिएको छ। सो वयानबाट त्यस बखतको स्थिति हामीले अनुमान लगाउन सक्छौं।

"होस-हवास हराएको दुई मिनेटपछि आँखा खोलेर हेर्दा चारैतिर प्रलयको दृश्य, प्रलयको कोकोहलो स्वरले चिच्याउनु र कराउनु लागेको देखियो, सुनियो। मानिसको ता के कुरो मानिसका शरणमा परेका चराचुरंगीहरू पनि च्याँ-च्याँ र चुँ-चुँ गरेर आकाशमा कराउनु लागेका थिए। मूसे जस्तो छरितो जन्तुले पनि भाग्ने मौका पाएन; जहाँको तहाँ थिचिएर मर्नु पर्‍यो।"

"छोराको सबै शरीर किचिइरहेछ, मुख पक्क-पक्क बाएको डँटका अन्तरबाट अलि-अलि देखिन्छ, आँमा भनेको मलीन आवाज अलि-अलि सुनिन्छ, डँट काठ पन्छ्याएर छोरो झिक्ने मद्दत पुग्दैन। यस्तो अवस्थामा त्यस अभागिनी आमाको तस्वीर झिक्नु होस्। जहानमा ११ जना थिए, सबै किचिएर मरे, एउटा पाँच वर्षको बालक बाँच्यो। यो टुहुरोको सन्झना गर्नुहोस्। विवाह गरेको वर्ष दिन भएको छैन १५ वर्षकी बाहुनी विधवा भई, यसले छाति पिटी-पिटी रोएको करुणाक्रन्दनको विचार गर्नुहोस्। जहानमा कसैको टाउको फुटेको छ, कसैको हात भाँचिएको छ, कुनै बेपत्ता छन्, कसैलाई खोचेर झिक्दै छन्, कसैलाई पोलन लगिसके। घ्याम्पो फुट्यो, अन्नको गेडा छैन। घरमा मुर्दा लडिरहेछ, कात्रो किन्न जाने पसल छैन, दाउरा किन्ने पैसा छैन। घर भत्केका काठपातले मुर्दा पोलिए। बाबु मर्‍यो, छोरोले किरिया गर्नालाई कपाल खौरने छुरा पाएन। पुहेत बाजेसँग किरिया गराउने पुस्तक छैन; घरले किचिएको छ, अथवा

कहाँ छ पत्तो छैन। किरिया पुत्रीले नयाँ धोति नपाएर पुरानो पटुका फेरेर किरिया बस्नु पर्‍यो। सारा शहर भत्क्यो, पसल भत्के, केही किन्न पाइँदैन। रात पर्‍यो, माघे झरी पर्ने डर छ, ओत छैन।

लास जलाउनलाई दाउरा नपाउँदा धेरैले भत्केका घरको काठले जलाए। सबै घाटहरूमा ठेलंठेला भयो। मुर्दाको सद्गत गर्न नशक्नेहरूले घाटमा मुर्दाहरू त्यसै फ्याक्न थाले, गाईवस्तुको त कुरै छाड्नु।"

वि.सं. २०२३ को भूकम्प

वि.सं. २०२३ साल आसार १३ गते सुदूर पश्चिमाञ्चल क्षेत्रमा भूकम्प गएको थियो। सो भूकम्पबाट २४ जनाको मृत्यु हुनका साथै १३ सयभन्दा बढी घरहरूको पूर्ण क्षति भएको थियो। यसबाट दार्चुला, बैतडी, बझाङ जिल्लाहरूलाई बढी प्रभावित पारेको थियो।

वि.सं. २०३७ को भूकम्प

वि.सं. २०३७ साल श्रावण १४ गते बझाङ जिल्लामा गएको भूकम्पबाट १६ जिल्लामा गरी १०३ जनाको मृत्यु भएको थियो। सो भूकम्पले २५०० भन्दा बढी घरहरूलाई क्षति पुऱ्याएको थियो। यस भूकम्पको माप ६.५ रिक्टर स्केलको थियो। यस क्षेत्रमा गएको यो भूकम्प करीब ६४ वर्ष पछिको ठूलो भूकम्प मानिन्छ। यस्तै वि.सं. २०३३ सालमा पनि त्यस क्षेत्रमा भूकम्प गएको थियो अनिन्छ। सोको अभिलेख प्राप्त भएको छैन।

वि.सं. २०४५ को भूकम्प

वि.सं. २०४५ साल आद्र ५ गते बिहान ४ बजेर ५४ मिनेट ३५ सेकेण्डमा नेपालको पूर्वी भाग उदयपुर जिल्लामा केन्द्र बिन्दु भएको ६.५ रिक्टर स्केलको एक भूकम्प गएको थियो। सो भूकम्प विगत ५५ वर्ष पछिको ठूलो भूकम्प थियो। उक्त भूकम्पमा ४० सेकेण्डसम्मको धक्का महसूस गरिएको थियो। सो भूकम्पबाट ७२१ जनाको मृत्यु र करिब ६५,००० भन्दा बढी घरलाई क्षति पुऱ्याएको थियो। यस भूकम्पले खासगरी पूर्वी नेपालको धरानलाई बढी असर पुऱ्याएको थियो। सो भूकम्पबाट भएको क्षतिको विवरण तालिका ४ मा प्रस्तुत गरिएको छ।

यसरी भूकम्पको ऐतिहासिक घटना केलाउने हो भने भूकम्पलाई सबैभन्दा विनाशकारी प्राकृतिक प्रकोप भन्न सकिन्छ। यसले विश्वका धेरै देशलाई दुःख दिइरहेको सर्वविदितै छ। खासगरी भूकम्पले देशको शहरी क्षेत्रमा बढी खतरा पुऱ्याएको छ। किनकि शहरी क्षेत्रमा पूर्वाधारको विकास र जनसंख्या धेरै हुने हुँदा भूकम्पीय प्रकोपले बढी क्षति पुऱ्याउने गर्छन्। उदाहरणको लागि नेपालमा गएको ऐतिहासिक भूकम्पहरूलाई लिन सकिन्छ। ती अधिकांश

भूकम्पहरूले काठमाडौं उपत्यकाका शहर लगायत अन्य शहरहरूमा प्रभाव पारेको थिए। यसरी अन्य देशहरूमा पनि भूकम्पबाट शहरी क्षेत्रमा बढी क्षति भएको हामीले याहा पाएका छौं। यस कारण भूकम्पजनित जोखिममा रहेका देशहरूमा शहरी क्षेत्रमा नै भूकम्पबाट हुने क्षति खतरापूर्ण छ। साथै यसैले होला संयुक्त राष्ट्र संघबाट मनाउदै आइएको प्राकृतिक प्रकोप न्यूनीकरण अन्तर्राष्ट्रिय दशक दिवशको यस वर्षको नारा “खतरामा रहेका शहरहरू” (Cities at Risk) भन्ने राखिएको छ।

### खतरामा रहेका शहरहरू

विश्वमा बढ्दो शहरीकरणको परिप्रेक्ष्यमा भूकम्प र अन्य प्राकृतिक प्रकोपबाट शहरी क्षेत्रमा भइरहेको खतरा दिन प्रतिदिन बढिरहेको सन्दर्भलाई दृष्टिगत गर्दा यस वर्षको नारा “खतरामा रहेका शहरहरू” (Cities at Risk) लाई सान्दर्भिक मान्नु पर्दछ। तसर्थ, यस किसिमको खतराबाट हुनसक्ने क्षतिलाई न्यूनीकरण गर्न आवश्यक देखिएको छ। यसको लागि विश्वमा भइरहेको शहरीकरणको स्थितिबारे विवेचना र विश्लेषण हुनु पनि जरुरी देखिन्छ।

### विश्वमा शहरीकरण

सन् १८५० सम्म विश्वमा कुनै पनि शहर थिएन। तर सन् २००० सम्म विश्वभरिमा १ करोड भन्दा बढी जनसंख्या भएका शहरहरू २० वटा पुग्ने अनुमान गरिएको छ। तालिका ५ बाट उक्त कुरा प्रष्ट हुन्छ।

तालिका ५ अनुसार २० वटा शहरहरू मध्ये १२ वटा एशिया प्रशान्त क्षेत्रमा पर्दछन्। र ती २० मध्ये १५ वटा

हामी जस्तै विकासोन्मुख देशमा पर्दछन्। साथै, ती मध्ये ३/३ वटा हाथो छिमेकी राष्ट्र चीन र भारतमा पर्दछन्। यसबाट हामीलाई प्रष्ट हुन्छ की विश्वमा शहरीकरणको स्थिति कस्तो छ। तसर्थ, यस्तो बढ्दो शहरीकरणलाई दृष्टिगत गर्दा शहरी क्षेत्रमा बढिरहेको खतरालाई ध्यानमा राख्न र यसको न्यूनीकरणतर्फ सोच्नु अति आवश्यक भएको छ।

### भूकम्पीय प्रकोपको न्यूनीकरण

विश्वमा नै प्राकृतिक प्रकोपबाट बढिरहेको खतरालाई ध्यानमा राखी संयुक्त राष्ट्र संघबाट सन् १९९० देखि सन् २००० सम्म प्राकृतिक प्रकोप न्यूनीकरण अन्तर्राष्ट्रिय दशक (International Decade for Natural Disaster Reduction, IDNDR) मनाउने निर्णय गरे अनुरूप हामी यस दशक मनाइरहेका छौं। यस दशक सम्बन्धी नेपालमा माननीय गृह मन्त्रीज्यूको अध्यक्षतामा एक राष्ट्रिय समिति गठन भई कार्य भइरहेको छ।

यस IDNDR दशकको उद्देश्य अनुरूप अन्तर्राष्ट्रिय भूकम्प इन्जिनियरिङ संघ (International Association for Earthquake Engineering, IAEE) ले एक मुनाफा नलिने (non-profit) उद्देश्य राखी एक संस्था World Seismic Safety Initiative (WSSI) को स्थापना गरेको छ। सो संस्थाले नेपालमा पनि सन् १९९२ मा एक उच्चस्तरीय बैठकको आयोजना गरेको थियो। यसलाई भूकम्पीय प्रकोपको न्यूनीकरणको एक पाइलाको रूपमा लिन सकिन्छ।

यस्तै अर्को पाइलाको रूपमा यो प्रकोप न्यूनीकरणका लागि अत्यावश्यक नेपालको राष्ट्रिय भवन निर्माण संहिता (National Building Code of Nepal) श्री ५ को सरकारले तर्जुमा गरिसकेको छ। सो लागू गर्नको लागि आवश्यक

### तालिका ४

२०४५ सालको भूकम्पबाट भएको क्षतिको विवरण

क्र.सं.	विवरण	पूर्वाञ्चल	मध्यमाञ्चल	जम्मा	क्षतिग्रस्त
१.	मानिस मृत्यु	६६८	५३	७२१	
२.	सम्पत्ति क्षति	१५७५	८२	१६५७	
३.	साधारण क्षति	४५०६	३९०	४८९६	६५५३
४.	व्यक्तिगत घर भत्केको	१६६४३	५३३३	२१९७६	
५.	व्यक्तिगत घर चर्की बस्न नहुने	३४९१७	७२८१	४२१९८	६४१७४
६.	सार्वजनिक भवन भत्केको	१००	५०	१५०	
७.	सार्वजनिक भवन चर्की बस्न नहुने	१४६	१७२	३१८	४६८
८.	सरकारी भवन भत्केको	२०३	२०	२२३	
९.	सरकारी भवन चर्की बस्न नहुने	४३१	१३६	५६७	७९०
१०.	क्षति भएकाले पञ्चायत भवन	१०३	५५	१५८	
११.	विद्यालय पूर्ण क्षति (अनुदान पाउने)	२०४	१४२	३४६	
१२.	विद्यालय आंशिक क्षति	२७४	३३०	६०४	
१३.	पशुधन क्षति	१३४१	२२५	१५६६	
१४.	क्षतिग्रस्त विकास आयोजना	१९८१	२७	२००८	

- कानूनी प्रकृया पूरा गर्नतर्फ कारवाही भइरहेको छ । सो संहितामा निम्न बमोजिम ३ खण्डमा समावेश गरिएको छ ।
- (क) भूकम्पजन्य खतराको सर्बेक्षण तथा जोखिमको स्तर निर्धारण गरिएको छ ।
- (ख) राष्ट्रिय भवन निर्माण संहिताको तर्जुमा तय र त्यसको कार्यान्वयनको लागि आवश्यक पूर्वाधारहरूको रूपरेखा तयार गरिएको छ ।
- (ग) बैकल्पिक निर्माण सामग्री एवं प्रविधि सम्बन्धी अध्ययन तथा सम्भावित उन्नत प्रविधिको छनौटको सुझाव दिइएको छ ।

सो भवन निर्माण संहिता (National Building Code) माथि उल्लेखित खण्डहरूको विरलेषण गरी भूकम्प प्रतिरोधात्मक उपायहरू समावेश गरी भवन निर्माण गर्ने तरिकाहरूको सुझाव दिइएका छन् । सो संहिता निम्न बमोजिम बर्गिकरण गरिएको छ ।

- (क) स्टेट अफ आर्ट डिजाइन ।
- (ख) इन्जिनियरिङ डिजाइन ।
- (ग) नन-इन्जिनियरिङ डिजाइन ।

(घ) गाइड लाइनस् फर ररल बिल्डिङ्ग ।

सो संहिता कार्यान्वयनमा आएपछि संहिताले भविष्यमा बनिने घरहरूलाई भूकम्प प्रतिरोधात्मक बनाउन सहयोग पुऱ्याउने छ । तर यस अघि बनेका घरहरूको भूकम्पीय सुरक्षात्मक स्थिति (Seismic Safety Condition) कस्तो हुन्छ ? यो एउटा जटिल प्रश्न हुने छ । यसको समाधान खोज्नु जरुरी छ । यस सम्बन्धमा प्राविधिक विशेषज्ञहरूले पुनः सुदृढिकरण (Retrofitting) उपायद्वारा समाधान गर्न सकिने सुझाव दिएका छन् । तर त्यसको लागि केही थप आर्थिक स्रोत आवश्यक पर्छ ।

यी सबै समस्याहरू समाधान गर्न प्रथमतः यी समस्याहरू कहाँ कहाँ छन् र कुन कुन अवस्थामा छन् यी सबै तथ्यहरू भूकम्प आउनु अघि थाहा पाए मात्र सोको समाधानको औचित्य हुन्छ ।

तसर्थ, यी सबै आवश्यक तथ्यहरू पहिचान गर्न हामीले प्रत्येक भूकम्पबाट जोखिम रहेका शहरहरूको “शहरी भूकम्पीय प्रकोप दृष्यपलट” (Urban Earthquake Disaster Scenario) तर्जुमा गर्नु अति आवश्यक देखिन्छ । यस

तालिका ५  
शहरीकरणको विवरण (१९५०-२०००)

सन् १९५०				सन् २०००			
क्र.सं.	शहर	देश	जनसंख्या	क्र.सं.	शहर	देश	जनसंख्या
१	न्यूयार्क	अमेरिका	१,२३ लाख	१	मेक्सीको	मेक्सीको	२,५६ लाख
२	लण्डन	बेलायत	८७ लाख	२	साओ पाओलो	ब्राजिल	२,२९ लाख
३	टोकियो	जापान	६७ लाख	३	टोकियो	जापान	१,९० लाख
४	पेरिस	फ्रान्स	५४ लाख	४	सांघाई	चीन	१,७० लाख
५	सांघाई	चीन	५३ लाख	५	न्यूयार्क	अमेरिका	१,६८ लाख
६	ब्यूनसआयर्स	अर्जेन्टिना	५० लाख	६	कलकत्ता	भारत	१,५७ लाख
७	शिकागो	मेरिका	४९ लाख	७	बम्बे	भारत	१,५४ लाख
८	मास्को	सोभियतसंघ	४८ लाख	८	बेइजिङ	चीन	१,४० लाख
९	कलकत्ता	भारत	४४ लाख	९	लसएन्जलस	अमेरिका	१,३९ लाख
१०	लसएन्जलस	अमेरिका	४० लाख	१०	जाकार्ता	इण्डोनेशिया	१,३७ लाख
११	बेइजिङ	चीन	३९ लाख	११	दिल्ली	भारत	१,३२ लाख
१२	ओसाका	जापान	३८ लाख	१२	ब्यूनसआयर्स	अर्जेन्टिना	१,२९ लाख
१३	मिलान	इटाली	३६ लाख	१३	लागोस	नाइजेरिया	१,२९ लाख
१४	मेक्सीको	मेक्सीको	३१ लाख	१४	तियानजिन	चीन	१,२७ लाख
१५	फिलाडेल्फिया	अमेरिका	२९ लाख	१५	सिउल	कोरिया	१,२७ लाख
१६	बम्बे	भारत	२९ लाख	१६	रियोदजनेरियो	ब्राजिल	१,२५ लाख
१७	रियोदजनेरियो	ब्राजिल	२९ लाख	१७	ढाका	बंगलादेश	१,२२ लाख
१८	देट्रोइट	अमेरिका	२८ लाख	१८	कायरो	इजिप्ट	१,१८ लाख
१९	नेपल्स	इटाली	२८ लाख	१९	मेट्रोमनिला	फिलिपिन्स	१,१८ लाख
२०	लेनिनग्राद	सोभियतसंघ	२६ लाख	२०	कराची	पाकिस्तान	१,१७ लाख

किसिमको अध्ययनबाट भूकम्पबाट हुनसक्ने क्षतिको पूर्वानुमान गर्न सकिन्छ । सोको पूर्व पहिचान गरी तिनीहरूलाई भूकम्पीय सुरक्षाको उपायहरू प्रयोग गरी भूकम्पबाट सुरक्षित बनाउन सकिन्छ । यस किसिमको योजना इक्वेडोरको क्वीटोमा तयार पारी त्यस शहरको स्कूलहरूमा भूकम्पीय सुरक्षाको उपाय समावेश गरी पुनः सुदृढीकरण (Retrofitting) गरिएको थियो । यस्तै अन्य देश अमेरिका, जापान इत्यादि देशहरूमा पनि यस्तो अध्ययन गरिएको छ ।

### निष्कर्ष

हजारौ परिवारको बिचल्ली भएको वि.सं. १९९० माघ २ गतेको भूकम्पले ल्याएको वियोग फेरि नदोहरिएला भन्न सकिन्न । त्यसैले भूकम्पबारे जनचेतना जागृत गराउने समेत उद्देश्यले हरेक वर्ष माघ २ गतेलाई संस्मरणको रूपमा 'भूकम्प दिवस' भनी घोषणा गरी त्यस अनुरूप मनाउनु सान्दर्भिक हुनेछ । सोही भूकम्पको संस्मरणमा निर्मित ऐतिहासिक 'भूगोल पार्क' को संरक्षण गरी त्यसको महत्त्वबारे जनचेतना जागृत गराउनु आवश्यक छ । किनकि १९९० सालको भूकम्प गएपछि पीडित परिवारहरूलाई तत्कालीन सरकारले वितरण गरेको ऋण वि.सं. १९९४ मा सो ऋण साफी गरी त्यसको सम्पूर्ण

तमसुक संकलन गरी सोही भूगोलपार्कमा निर्मित स्तम्भभित्र राखी भूगोल अड्याइएको छ । उक्त स्तम्भ सोही भूकम्पको संस्मरणमा बनाइएको हो । सो स्तम्भमा नै प्रत्येक वर्ष माघ २ गते भूकम्प दिवसको समारोह आयोजना गरेमा भूकम्पबाट दिवंगत हुनेहरूप्रति उचित श्रद्धाञ्जलि पुग्न जाने छ ।

भूकम्पीय जोखिम क्षेत्रमा परेको नेपालमा पुनः कहिले भूकम्प आउँछ सोको पूर्व अनुमान गर्न गाह्रो छ । तर पनि २०५१ साल पुष ६ गते बुधबार कान्तिपुरमा प्रकाशित समाचार अनुसार अमेरिकी भू-गर्वविद्हरूद्वारा नेपाल र उत्तरी भारतमा भूकम्पको सम्भावना रहेको अनुमान गरिएको छ । निजहरूले गरेको अध्ययन अनुसार उत्तरी भारत र मध्य हिमाली क्षेत्रमा सो भूकम्पले ठूलो असर पार्ने छ । सो भूकम्प ८ वा ९ रेक्टर स्केलसम्मको हुनसक्ने अनुमान गरिएको छ । यस भूकम्पले यस क्षेत्रमा लगभग २० करोड जनसंख्यालाई प्रत्यक्ष असर पार्नेछ ।

तसर्थ, सो भूकम्प आउनु अघि हामी पूर्व तयारीमा हुनु जरुरी छ । यसको लागि सो भूकम्पबाट हुनसक्ने क्षतिको न्यूनीकरण गर्नलाई हामीले तुरुन्त उपायहरू सोच्नु पर्छ भन्ने कुरामा दुइमत छैन । यसकारण हामी सबै प्राविधिक, शिक्षक, विद्यार्थी, पत्रकार, कर्मचारी, राजनीतिज्ञ, समाजसेवी, सबै जनता यस भूकम्पीय जोखिमको न्यूनीकरणको लागि आ-आफ्नो क्षेत्रबाट प्रयास थालौ ।

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# **Second Nepal Geological Congress**

**11-13, November, 1997**

**Kathmandu**

The Nepal Geological Society is highly encouraged by the response received to the first circular. The Society is thankful to all those who have quickly responded to our call. So far, we have received positive response from over 100 participants from different countries, and many of them have shown their interest to contribute scientific research papers. In addition, we expect more than 200 Nepalese scientists/engineers to participate in the event.

The Congress will be convened in Kathmandu at 9 A.M. on **November 11, 1997** and end with the evening session of 13th November, 1997. We recommend you to arrive at Kathmandu on the **November 10, 1997** for an early Registration. Candidates attending the field excursion(s) may plan their arrival accordingly. Further information on the Congress program, venue, address for contact after arrival etc. will be given in the Third Circular which will be sent to all respondents by the end of **August 1997**. Entry Visas are required to all foreign nationals except Indian nationals. Visas are obtainable from Royal Nepalese Embassies and Consulates abroad.

## **ABSTRACTS**

Abstracts should reach the organizers latest by **30th July, 1997**. All the accepted abstracts will be published in the Special Issue of the Journal of Nepal Geological Society (Vol. 16) after necessary editing. The abstracts should not exceed two typed pages (maximum 1000 words) inclusive of figures. An electronic copy of the Abstracts will be appreciated. Inclusion of small camera-ready figures is encouraged. Authors of papers accepted for presentation will be informed by the end of **August, 1997**.

## **PUBLICATION**

We plan to publish the full papers presented in the Congress in an Special Issues of the Journal of Nepal Geological Society (Vol. 18) by the end of November, 1998. Therefore, the authors are requested to indicate in advance if they wish to publish their full paper in the journal. For the timely publication of the special issue, two hard copies of the manuscript (generally not exceeding 10,000 words) with all tables and figures in camera-ready form and an electronic copy should be submitted to the organizers latest by **13<sup>th</sup> November, 1997**. The authors may refer to the latest issues of the Journal of Nepal Geological Society for standard paper format.

## **REGISTRATION FEE**

The Registration Fee will be as follows:

Participants from SAARC Countries US\$ 30.00 (NRs. 1700)

Participants from other countries US\$ 60.00

A discount of 50% will be provided to the student participants.

The Registration Fee is inclusive of the Abstract Volume, three warm lunches and tea/coffee, and transportation to/from the Congress Venue.

## **FINANCIAL SUPPORT**

A very limited fund has been received from the International Centre for Integrated Mountain Development (ICIMOD), Kathmandu for facilitating participation of geoscientists from countries of Hindu Kush-Himalayan Region. So only partial support could be provided to a small number of deserving candidates. Request for financial support may be sent to the Convenor latest by **August 15, 1997**. No financial support will be provided for the field excursion.

## EXCURSION FEE

The fees for the field excursions are as follows:

**Excursion 1. West Nepal:** (Kathmandu-Butwal-Surai Khola-Butwal-Tansen-Pokhara-Kathmandu):

An excursion by bus to see the geology of Siwaliks and the Lesser Himalaya (7-10 November, 1997). Minimum No. of Participants - 10.

**Fee. US\$ 170.00** (Inclusive of literature/maps, bus transport, 3 overnight stays in local non-star hotels (shared basis), 3 breakfast and seven lunch/dinner)

**Excursion 2. Kathmandu-Kodari (Nepal-China border):** An excursion by bus along the Arniko Highway, to see the crystalline rocks of the Kathmandu Nappe, the Lesser Himalayan sequence (the Nawakot Complex) and the MCT (14-15 November, 1997). Minimum No. of Participants - 10.

**Fee US\$ 85.00** (Inclusive of literature/maps, bus transport, overnight stay in local hotel (shared basis), 1 breakfast and 3 lunch/dinner)

**Accommodation:** November is the peak tourist season in Nepal, so prior hotel reservation is necessary. Arrangements have been made with the following hotels in Kathmandu to provide special discounts (20-50%) on their normal rates for the Congress participants.

Hotel		Single	Double
Yak & Yeti	US\$	115.00	125.00
Sherpa	US\$	105.00	115.00
Shangri-la	US\$	115.00	130.00
Blue Star	US\$	92.00	110.00
Ambassador	US\$	25.00	30.00
Kathmandu			
Guest House	US\$	25.00	30.00
Shakti	US\$	10.00	16.00

We request the participants to send the Registration Fee (along with the field excursion fee, if applicable) and one day's hotel room tariff in advance to the convenor by 20<sup>th</sup> of October, 1997. Payment should be made by Demand Draft drawn in favour of Nepal Geological Society, Nepal Arab Bank Limited, Kantipath, Kathmandu, Nepal

## REFUND

The advanced payments can be refunded (less bank handling charges) only, if notice to the effect is received by the organizers on/before 25<sup>th</sup> of October 1997.

## WEATHER

Weather in Kathmandu (average altitude about 1400 m) during the early November will be cold (Maximum 25°C and minimum 10°C). We advise you to come with winter clothing.

We warmly invite all the geoscientists interested in the Karakorum-Hindukush-Himalaya-Tibet region to attend the Congress. The final program will be sent in the Third Circular.

All correspondence should be addressed to:

Dr. B. N. Upreti  
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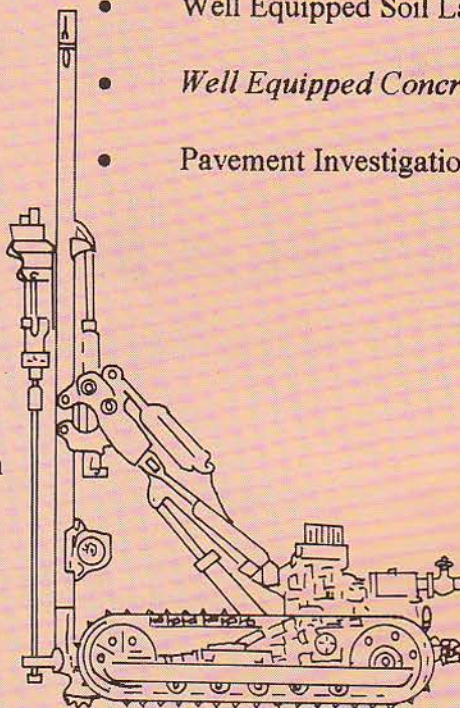
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